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RADIOLOGICAL HEALTH DATA

MONTHLY REPORT

AUGUST 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

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Public Health Service

Division of Radiological Health

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing ***Radiological Health Data.*** This publication is issued monthly, with each third issue (starting July 1960) expanded somewhat into a quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

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SECTION I

MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The U. S. Public Health Service Milk Monitoring Network presently consists of 12 sampling stations. This is being expanded to about 60 stations during the summer of 1960.

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing since it is among the most important elements of the diet and is constantly available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs.

The selection of the present 12 sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.

2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.

3. The milk samples were from a supply that was part of a metropolitan milkshed.

4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000 cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000 gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, and the strontium-90 is calculated by measuring the build-up of the daughter decay product, yttrium-90 (after about a two week wait) using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

Publication of the data will normally require a period of about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

Detailed technical descriptions of the methodology of analyses are listed below:

"Determination of I-131, Cs-137 and Ba-140 in Fluid Milk by Gamma Spectroscopy." By G. R. Hagee, G. R. Karches and A. S. Goldin, Public Health Service.

"A Method for the Rapid Ashing of Milk for Radionuclide Analysis," Journal of Dairy Science, 42-1288, Aug. 1959. By G. K. Murthy, J. E. Campbell.

"A Method for the Determination of Radionuclides in Milk Ash," Journal of Dairy Science, 14-1276, Aug. 1959. By G. K. Murthy, L. P. Jarnagin, and A. S. Goldin.

"A Method for the Elimination of Ashing in Strontium-90 Determination of Milk," Journal of Dairy Sciences, 43 (2) 151, Feb. 1960. By G. K. Murthy, J. E. Coakley and J. E. Campbell.

TABLE I.—PUBLIC HEALTH SERVICE DATA ON RADIOACTIVITY IN MILK

MARCH 1960

Data from one sampling point supplying the areas listed below

Radioactivity in $\mu\mu c$/liter

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average
Atlanta, Ga.	1.12	1.16	(a) 35	(a) 5	(a) 0	27	18.7	16.8	(a) 0	(a) 0	65	79
Austin, Tex.	1.14	1.11	20	3	0	12	4.8	6.0	0	0	25	40
Chicago, Ill.	1.06	1.09	0	0	0	10	10.1	9.4	0	0	40	50
Cincinnati, Ohio	1.09	1.12	0	< 1	0	13	12.5	12.7	0	0	40	45
New York, N. Y.	1.09	1.07	0	1	0	7	10.9	10.2	0	0	40	49
Overton, Nev.	1.03	1.08	0	0	0	1	3.8	3.4	0	0	15	27
Sacramento, Calif.	1.04	1.10	0	< 1	0	7	4.2	4.4	0	0	20	35
Salt Lake City, Utah	1.11	1.10	0	2	0	7	10.0	7.6	0	0	55	46
Spokane, Wash.	1.06	1.15	0	2	0	18	12.6	13.3	0	0	60	66
St. George, Utah	1.02	1.10	0	< 1	0	4	3.6	4.2	0	0	20	27
St. Louis, Mo.	1.17	1.26	0	0	0	38	20.5	22.3	0	0	45	71

(a) Zero means below detectability.

ATOMIC ENERGY COMMISSION DATA ON RADIOACTIVITY IN MILK

Routine milk monitoring is conducted at New York City, Perry, New York, and Mandan, North Dakota, with analyses performed at the Atomic Energy Commission's New York Health and Safety Laboratory. Data for these three locations for the months of January, February and March, 1960 are presented below. Data for previous months were given in HASL-Reports; the most recent being listed below* and Radiological Health Data, April, May, and June, 1960.** A list of publications for previous data may be found in Radiological Health Data, April 1960.

TABLE II.—STRONTIUM-90 AND CALCIUM IN JANUARY, FEBRUARY, AND MARCH, 1960 MILK

Health and Safety Laboratory (HASL) Sampling Locations

Sampling station location	Strontium-90			Calcium	
	$\mu\mu c$/l. (fluid)	$\mu\mu c$/kg. (powder)	$\mu\mu c$/ gm Ca.	gm/l. (fluid)	gm/kg. (powder)
Perry, N. Y. (Powdered milk)					
January		76.0	8.6		8.8
February		63.8	7.4		8.7
March		64.8	7.3		8.9
New York City (Liquid milk)					
January	9.3		8.1	1.2	
February	9.4		8.9	1.1	
March	9.5		9.1	1.1	
Mandan, N. Dak. (Powdered buttermilk)					
January		234	22.6		10.3
February		236	21.8		10.8
March		238	22.5		10.6

*Health and Safety Laboratory Fallout Program Quarterly Summary Report, April 1960, available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., for $3.50.

**U. S. Department of Health, Education, and Welfare Publications available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. Price 50 cents single issue.

SECTION II

AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout during nuclear weapons tests. The program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 44 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. These data alone are not conducive to evaluation directly of biological hazards. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to the laboratory in Washington for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 44 stations on an average of 70% of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85% of the stations collect samples of precipitation which are sent to Washington for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table III presents a summary of the latest monthly data.

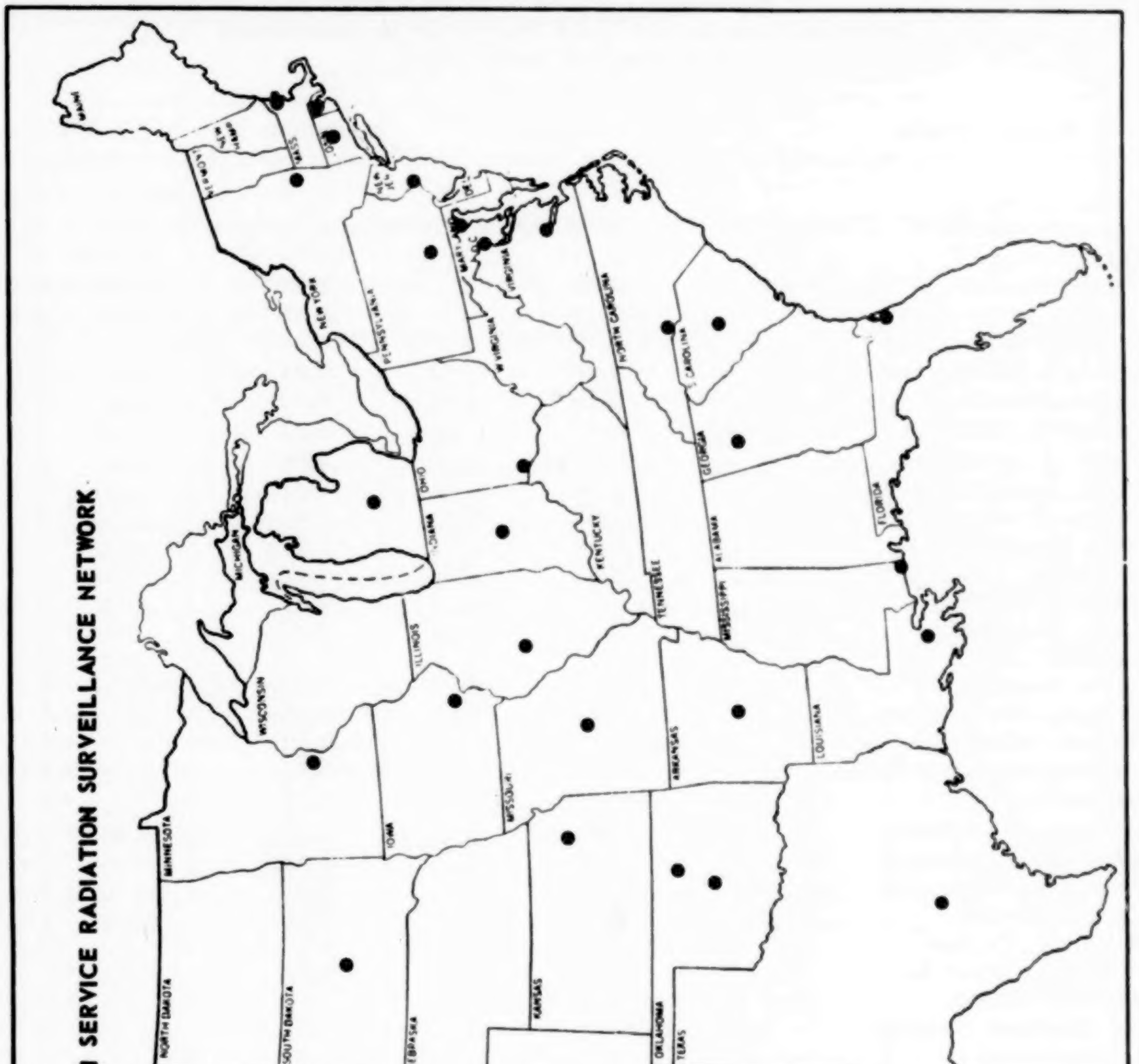

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK
Anchorage, Alaska
Juneau, Alaska
Fairbanks, Alaska
Honolulu, Hawaii
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
MASS.
D.C.

FIGURE 1

TABLE III.—PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Radioactivity of Particulates in Air
Micromicrocuries Per Cubic Meter—Gross Beta Counts
For month of March 1960

Station location	Weighted average	Maximum	Minimum
Alaska, Anchorage	< 0.16	0.27	< 0.10
Alaska, Fairbanks	< 0.14	0.24	< 0.10
Alaska, Juneau	< 0.12	0.20	< 0.10
Arizona, Phoenix	0.48	1.13	< 0.25
Arkansas, Little Rock	< 0.15	0.28	< 0.10
California, Berkeley	< 0.17	0.48	< 0.10
California, Los Angeles	< 0.26	0.81	< 0.10
Colorado, Denver	< 0.29	0.70	< 0.10
Connecticut, Hartford	< 0.13	0.22	< 0.10
District of Columbia	< 0.20	0.46	< 0.10
Florida, Jacksonville	< 0.23	0.34	< 0.10
Georgia, Atlanta	< 0.22	0.43	< 0.10
Hawaii, Honolulu	< 0.30	1.00	< 0.10
Idaho, Boise	0.42	0.69	0.16
Illinois, Springfield	0.21	0.41	< 0.12
Indiana, Indianapolis	< 0.15	0.25	< 0.10
Iowa, Iowa City	< 0.14	0.20	< 0.10
Kansas, Topeka	< 0.16	0.28	< 0.10
Louisiana, New Orleans	0.24	0.26	0.20
Maryland, Baltimore	< 0.18	0.30	< 0.10
Massachusetts, Lawrence	< 0.11	0.15	< 0.10
Michigan, Lansing	< 0.16	0.23	< 0.10
Minnesota, Minneapolis	< 0.14	0.22	< 0.10
Mississippi, Pascagoula	0.36	0.62	< 0.20
Missouri, Jefferson City	< 0.15	0.21	< 0.10
Montana, Helena	< 0.20	0.47	< 0.10
New Jersey, Trenton	< 0.17	0.43	< 0.10
New Mexico, Santa Fe	< 0.35	0.90	< 0.10
New York, Albany	< 0.12	0.19	< 0.10
North Carolina, Gastonia	< 0.28	0.54	< 0.10
Ohio, Cincinnati	0.27	1.40	0.10
Oklahoma, Oklahoma City	< 0.18	0.36	< 0.10
Oklahoma, Ponca City	< 0.10	0.17	< 0.10
Oregon, Portland	< 0.22	0.50	< 0.10
Pennsylvania, Harrisburg	< 0.18	0.29	< 0.10
Rhode Island, Providence	< 0.14	0.22	< 0.10
South Carolina, Columbia	< 0.20	0.30	< 0.10
South Dakota, Pierre	< 0.18	0.32	< 0.10
Texas, Austin	< 0.18	0.28	< 0.10
Texas, El Paso	0.67	1.46	0.16
Utah, Salt Lake City	0.29	0.54	< 0.10
Virginia, Richmond	< 0.14	0.20	< 0.10
Washington, Seattle	< 0.16	0.27	< 0.10
Wyoming, Cheyenne	< 0.21	0.35	< 0.10

TABLE IV.—RADON AND THORON AIR MEASUREMENTS

March 1, 1960, through March 31, 1960
Cincinnati, Ohio

RADIATION SURVEILLANCE NETWORK

(Beta activity included)

Date	Continuous sample collection			Beta (a) activity $\mu\mu c/M^3$	Radon (b) AM $\mu\mu c/M^3$	Radon (c) PM $\mu\mu c/M^3$	Thoron (d) $\mu\mu c/M^3$
	Sample change time	Sampling period (hours)	Volume M^3				
Mar. 1	0806	23.9	27.2	0.4	210	100	0.3
2	0804	23.9	28.5	0.2	179	99	0.5
3	0812	24.0	28.4	0.1	102	46	0.6
4	0810	23.9	28.1	0.2(3)	79	93	0.2
7	0810	71.9	85.6	0.2	98	146	0.3
8	0809	23.9	27.0	0.5	511	70	0.5
9	0812	24.0	26.5	0.1	86	36	0.2
10	0820	23.9	27.4	0.0	142	86	0.1
11	0815	23.8	23.9	0.2(3)	114	89	0.3
14	0821	72.0	82.1	0.1	425	72	0.9
15	0810	23.7	27.6	0.2	153	84	0.2
16	0800	23.7	28.4	0.2	113	74	0.3
17	0800	23.8	28.4	0.2	91	56	0.2
18	0810	24.0	27.9	0.1(3)	73	37	0.2
21	0810	71.8	85.7	0.2	60	38	0.3
22	0815	23.9	28.5	0.3	52	32	0.2
23	0806	23.8	27.8	0.2	37	39	0.5
24	0808	23.9	28.0	0.2	86	75	0.4
25	0810	24.0	28.1	0.1(3)	41	111	0.4
28	0808	71.9	82.0	0.5	259	54	3.5
29	0806	23.9	27.1	1.4	234	92	3.8
30	0808	23.9	28.0	0.5	67	92	1.3
31	0806	23.9	28.2	0.2	123	54	0.7
	Average..			0.26	145	72	0.6

(a) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

(b) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(c) Filters are temporarily withdrawn from sampler at about 3 p.m. and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 a.m. the following day.

(d) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

U. S. NAVAL RESEARCH LABORATORY

Data on Radioactivity in Air

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during April 1960 is shown in Table V, while the radioactivity profile for the same month is shown in Figure 2. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site. (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter.)

TABLE V.—U. S. NAVAL RESEARCH LABORATORY DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION

April 1960

Day	Disintegrations/minute per cubic meter of air						
	Punta Arenas	Puerto Montt	Santiago	Antofagasta	Chacaltaya	Lima	Guayaquil
1	0.07	-	0.17	0.13	0.03	0.03	0.09
2	0.04	0.08	0.05	0.08	0.03	0.02	0.07
3	0.04	0.08	0.05	0.08	0.03	0.02	0.07
4	0.04	0.08	0.05	0.08	0.03	0.02	0.07
5	-	0.02	0.12	0.08	0.04	0.05	0.07
6	-	0.02	0.12	0.08	0.04	0.05	0.05
7	-	0.06	0.05	0.08	0.08	0.05	0.02
8	0.02	0.06	0.05	0.08	0.08	0.05	0.12
9	0.02	0.07	0.12	0.09	0.03	0.03	0.07
10	0.02	0.07	0.12	0.09	0.03	0.03	0.07
11	0.02	0.07	0.12	0.09	0.03	0.03	0.07
12	0.01	0.05	0.12	0.11	0.04	0.07	0.07
13	0.01	0.05	0.12	0.11	0.04	0.07	0.07
14	0.03	0.05	0.10	0.07	0.01	0.03	0.07
15	0.03	0.05	0.10	0.07	0.01	0.03	0.06
16	0.03	0.05	0.08	0.07	0.02	0.03	0.06
17	0.03	0.05	0.08	0.07	0.02	0.03	0.05
18	0.03	0.05	0.08	0.07	0.02	0.03	0.05
19	0.02	0.02	0.10	0.07	0.03	0.03	0.07
20	0.02	0.02	0.10	0.07	0.03	0.03	0.07
21	-	0.03	0.05	0.09	0.03	0.05	0.06
22	-	0.03	0.05	0.09	0.03	0.05	0.06
23	-	0.06	0.08	0.06	0.06	0.03	0.07
24	-	0.06	0.08	0.06	0.06	0.03	0.07
25	-	0.06	0.08	0.06	0.06	0.03	0.07
26	-	0.08	0.12	0.07	0.05	0.05	0.07
27	-	0.08	0.12	0.07	0.05	0.05	0.07
28	-	0.02	0.09	0.08	0.03	0.03	0.07
29	-	0.02	0.09	0.08	0.03	0.03	0.07
30	-	0.05	-	0.05	0.03	0.03	0.07
Mean value	0.03	0.05	0.09	0.08	0.04	0.04	0.07

TABLE V.—U. S. NAVAL RESEARCH LABORATORY DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION—Con.

April 1960

Day	Disintegrations/minute per cubic meter of air							
	Mira-flores	San Juan	Mauna Loa	Miami	Wash-ington	Moosonee	Thule	Bravo*
1	0.13	0.12	0.27	0.43	0.91	0.44	0.31	0.26
2	0.11	0.28	0.30	0.28	0.08	0.39	0.43	0.26
3	0.11	0.28	0.30	0.28	0.08	0.35	0.43	0.26
4	0.11	0.28	0.30	0.28	0.08	0.16	0.43	0.26
5	0.12	0.64	0.31	0.25	0.25	0.44	0.44	0.15
6	0.12	0.64	0.31	0.85	0.25	0.51	0.44	0.15
7	0.24	0.64	0.24	0.74	0.60	0.58	0.45	0.15
8	0.24	0.64	0.24	0.74	0.60	0.60	0.45	0.15
9	0.23	0.48	0.18	0.63	0.38	0.53	0.35	0.15
10	0.23	0.48	0.18	0.63	0.38	0.53	0.35	0.15
11	0.23	0.21	0.18	0.63	0.38	0.71	0.35	0.31
12	0.31	0.21	0.24	0.77	0.71	0.30	0.31	0.31
13	0.31	0.21	0.24	0.77	0.71	0.55	0.31	0.31
14	0.46	0.21	0.17	0.83	0.77	0.53	0.29	0.31
15	0.46	0.21	0.17	0.83	0.77	0.30	0.29	0.31
16	0.22	0.45	0.16	0.81	0.74	0.37	0.25	0.31
17	0.22	0.45	0.16	0.81	0.74	0.37	0.25	0.31
18	0.22	0.45	0.16	0.81	0.74	0.39	0.25	0.31
19	0.37	0.35	0.29	0.60	0.45	0.48	0.33	0.29
20	0.37	0.35	0.29	0.60	0.45	0.41	0.33	0.29
21	0.31	0.35	0.46	0.55	0.83	0.44	0.38	0.29
22	0.31	0.35	0.46	0.55	0.83	0.41	0.38	0.29
23	0.22	0.19	0.39	0.41	0.79	0.21	0.38	0.29
24	0.22	0.19	0.39	0.41	0.79	0.21	0.38	-
25	0.22	0.19	0.39	0.41	0.79	0.32	0.33	-
26	0.08	0.19	0.27	0.23	0.52	0.21	0.33	-
27	0.08	0.19	0.27	0.23	0.52	0.39	0.33	-
28	0.11	0.15	-	0.36	0.25	0.32	0.31	-
29	0.11	0.15	-	0.36	0.25	0.55	0.31	-
30	0.05	0.13	-	0.39	0.39	0.37	0.31	-
Mean value	0.22	0.32	0.27	0.55	0.53	0.41	0.35	0.26

* Arctic Ice Floe Station "Bravo."

FIGURE 2

Average Measurements of Surface Air at 13 Stations Along 80th Meridian

April 1960

U. S. NAVAL RESEARCH LABORATORY

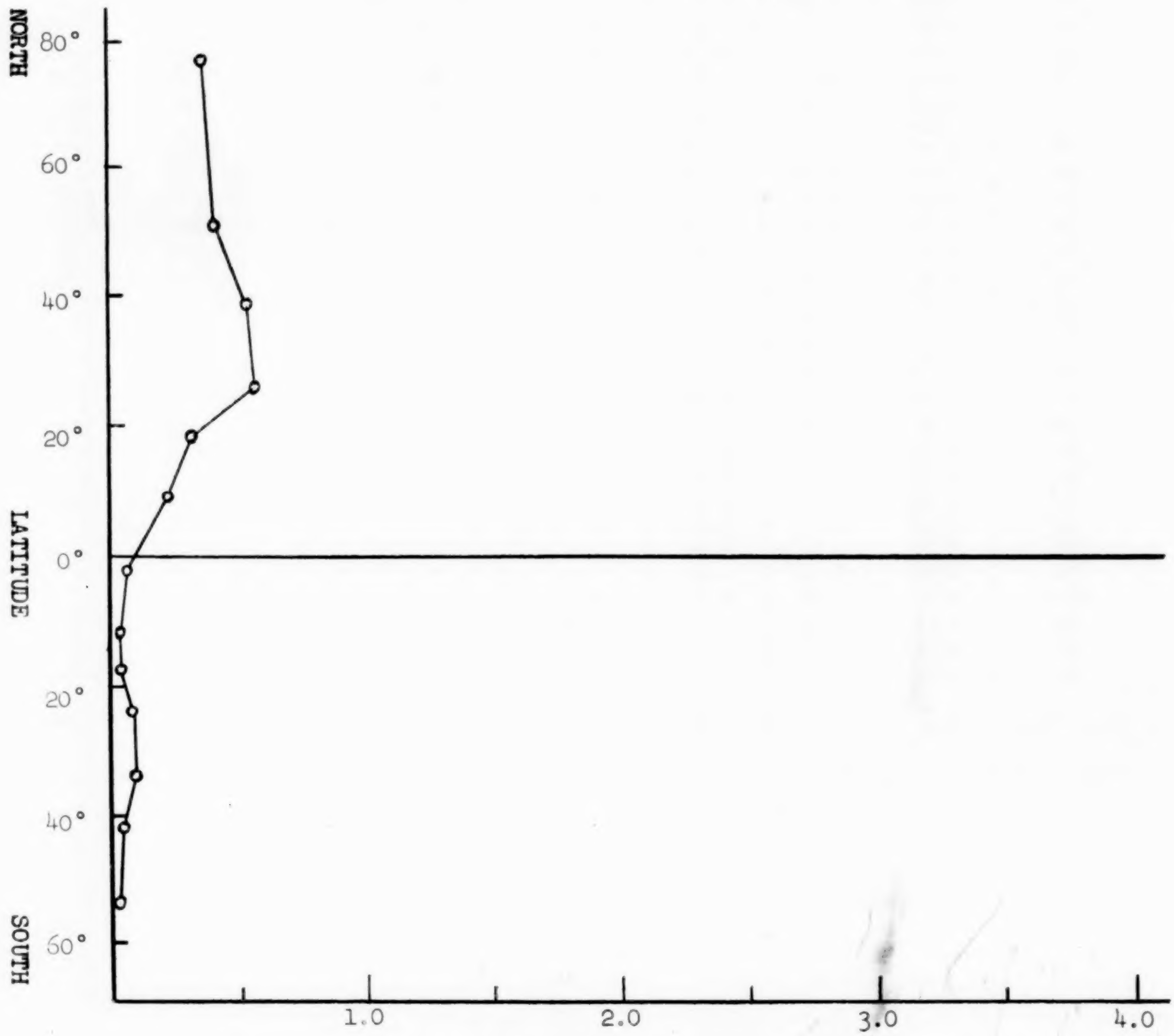


TABLE VI.—DATA ON RADIOACTIVITY IN THE AIR AT LEMONT, ILLINOIS

Argonne National Laboratory—Atomic Energy Commission

Air filter measurements of ground level air at Argonne National Laboratory for September 1959 to March 1960 have been reported to the Atomic Energy Commission by Dr. Philip F. Gustafson. In the table below, activity is expressed in micromicrocuries per 100 cubic meters of air.

Isotope	1959				1960		
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Zr^{95}-Nb^{95}	0.77	0.28	0.22	0.12	0.11	0.07	0.05
Cs^{137}	0.34	0.23	0.20	0.18	0.30	0.23	0.21
Ru^{106}	1.28	0.77	0.60	0.35	0.45	0.30	0.15
Ce^{144}	3.28	2.07	2.05	1.49	1.61	1.93	1.80
Rh^{102}(1)	0.4	0.7	1.6	2.0	2.3	3.6	4.1
W^{185}(2)	99	39	92	56	40	60	63

(1) Corrected for decay back to mid-August 1958. This isotope first appeared in ground level air in September 1959.
(2) Corrected for decay back to mid-June 1958.

SECTION III

WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provisions of Section 4(c) of Public Law 660, which states that ". . . the Surgeon General shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. There are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained. Radioactivity determinations are made on single samples, taken weekly.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than 1 week. Beginning with samples taken in January 1960, beta determinations are to be performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

Strontium-90 data are reported as being the results of determinations on composite sample for a three-month period ending in the month shown.

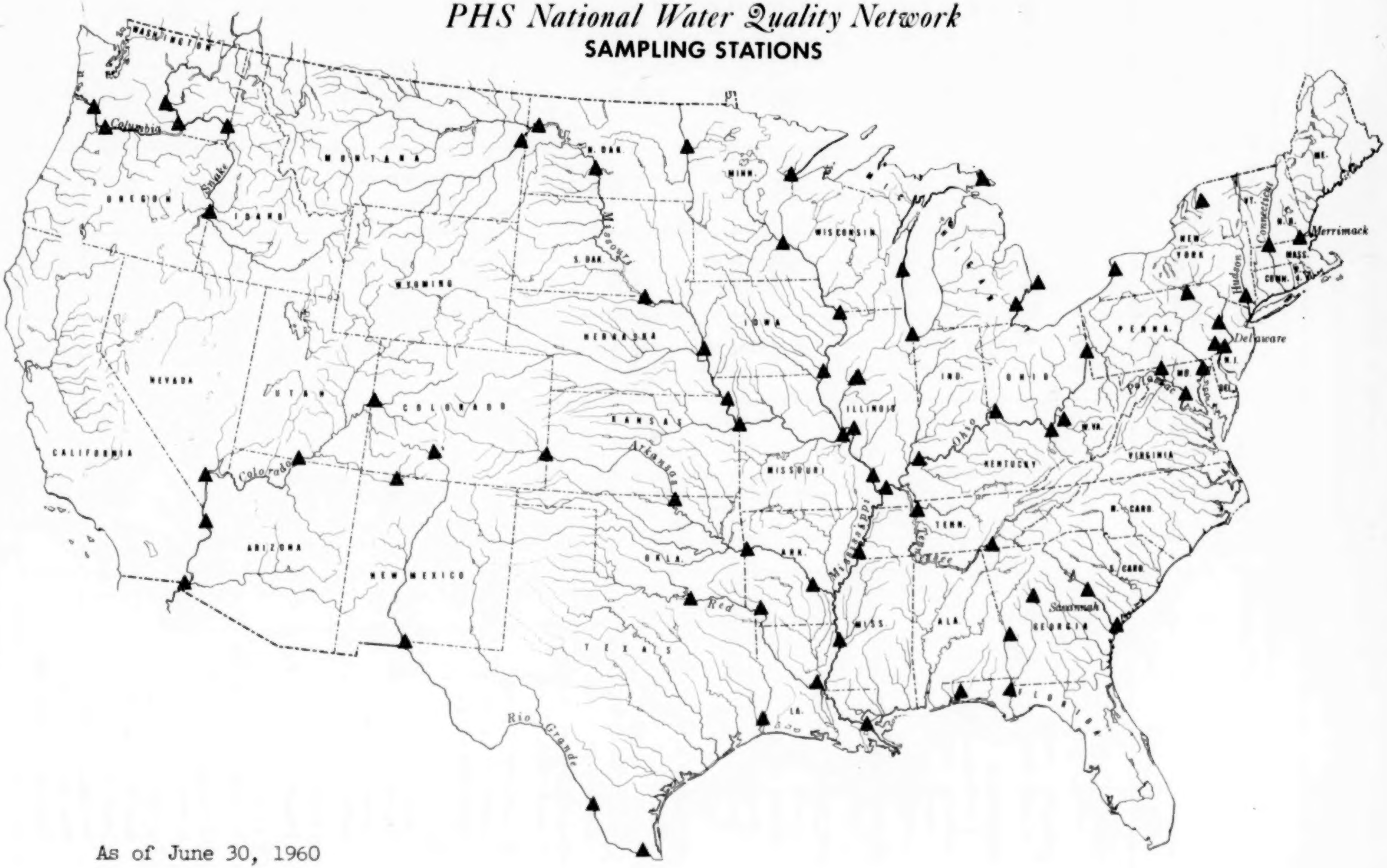
Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, Pages 167-169.

FIGURE 3

PHS National Water Quality Network
SAMPLING STATIONS



As of June 30, 1960

TABLE VII.—U. S. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK
RADIOACTIVITY IN RAW SURFACE WATERS

(Micromicrocuries per liter)

Station	Quarter ending 12/31/59	Month of February 1960 (Average to nearest whole number)					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Dis.	Tot.	Susp.	Dis.	Tot.
ALSEA RIVER							
Alsea, Oreg.	0.2	0	0	0	0	0	0
ANIMAS RIVER							
Cedar Hill, N. Mex.	-	72	59	131	28	24	52
ARKANSAS RIVER							
Coolidge, Kans.	0.4	0	44	44	0	58	58
Ponca City, Okla.	0.6	12	5	17	0	0	0
Fort Smith, Ark.	1.2	-	-	-	-	-	-
Pendleton Ferry, Ark.	0.6	48	6	54	4	0	4
CHATTAHOOCHIE RIVER							
Columbus, Ga.	0.2	2	0	2	0	5	5
COLORADO RIVER							
Loma, Colo.	0.3	8	2	10	8	8	16
Page, Ariz.	0.3	64	12	76	30	8	38
Hoover Dam, Ariz.-Nev.	0.7	0	16	16	<1	6	6
Parker Dam, Ariz.-Calif.	0.7	6	12	18	<1	6	6
Yuma, Ariz.	0.6	4	5	9	0	6	6
COLUMBIA RIVER							
Wenatchee, Wash.	0.8	1	3	4	0	0	0
Pasco, Wash.	0.9	106	411	517	0	0	0
Bonneville Dam, Oreg.	1.0	76	162	238	0	0	0
Clatskanie, Oreg.	0.5	15	66	81	0	<1	0
CONNECTICUT RIVER							
Northfield, Mass.	0.3	0	1	1	0	0	0
DELAWARE RIVER							
Martin's Creek, Pa.	-	1	2	3	0	0	0
Philadelphia, Pa.	0.6	3	4	7	0	1	1
GREAT LAKES							
Gary, Ind.	0.4	0	6	6	0	1	1
Duluth, Minn.	0.3	0	0	0	0	0	0
Detroit, Mich.	0.7	0	0	0	0	0	0
Buffalo, N. Y.	1.1	0	0	0	0	0	0
HUDSON RIVER							
Poughkeepsie, N. Y.	1.3	0	1	1	1	1	2
KANAWHA RIVER							
Winfield Dam, W. Va.	-	0	0	0	0	0	0
MERRIMACK RIVER							
Lowell, Mass.	0.5	0	0	0	1	1	2
MISSISSIPPI RIVER							
Red Wing, Minn.	0.7	0	16	16	0	2	2
Dubuque, Iowa	1.4	1	3	4	0	1	1
Burlington, Iowa	1.0	0	2	2	1	1	2
East St. Louis, Ill.	0.5	1	0	1	1	2	3
Cape Girardeau, Mo.	0.4	4	5	9	6	2	8

TABLE VII.—U. S. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK RADIOACTIVITY IN RAW SURFACE WATERS— Con.

(Micromicrocuries per liter)

Station	Quarter ending 12/31/59	Month of February 1960 (Average to nearest whole number)					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Dis.	Tot.	Susp.	Dis.	Tot.
MISSISSIPPI—Con.							
W. Memphis, Ark.	1.3	17	24	41	3	0	3
Delta, La.	1.0	13	6	19	6	1	7
New Orleans, La.	0.9	16	8	24	7	1	8
MISSOURI RIVER							
Williston, N. Dak.	0.5	-	-	-	-	-	-
Bismarck, N. Dak.,	0.9	2	2	4	0	5	5
Yankton, S. Dak.	0.5	0	6	6	0	1	1
Omaha, Nebr.	1.0	2	8	10	1	3	4
St. Joseph, Mo.	0.4	2	4	6	0	5	5
Kansas City, Kans.	0.7	6	6	12	0	4	4
St. Louis, Mo.	0.6	18	11	29	6	2	8
OHIO RIVER							
East Liverpool, Ohio	0.6	0	0	0	1	0	1
Huntington, W. Va.	0.2	16	11	27	1	0	1
Cincinnati, Ohio	0.8	10	0	10	4	0	4
Evansville, Ind.	-	11	2	13	2	<1	3
Cairo, Ill.	1.2	6	0	6	1	0	1
POTOMAC RIVER							
Williamsport, Md.	0.5	0	0	0	0	0	0
Great Falls, Md.	0.4	<1	0	<1	0	0	0
RED RIVER							
Denison, Tex.	1.9	0	0	0	0	0	0
Index, Ark.	0.9	2	5	7	2	2	4
Alexandria, La.	1.6	14	1	15	3	1	4
RIO GRANDE RIVER							
Laredo, Tex.	0.7	4	10	14	0	3	3
Brownsville, Tex.	0.3	0	117	117	1	0	1
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.3	0	1	1	0	0	0
SCHUYLKILL RIVER							
Philadelphia, Pa.	-	0	<1	<1	0	<1	<1
SAVANNAH RIVER							
North Augusta, S. C.	0.7	-	-	-	-	-	-
Port Wentworth, Ga.	0.7	1	4	5	0	0	0
SNAKE RIVER							
Wawawai, Wash.	0.4	<1	0	<1	0	1	1
TENNESSEE RIVER							
Chattanooga, Tenn.	1.1	3	87	90	0	0	0
YELLOWSTONE RIVER							
Sidney, Mont.	0.7	0	<1	<1	0	1	1

STRONTIUM-90 IN TAP WATER

HEALTH AND SAFETY LABORATORY—ATOMIC ENERGY COMMISSION

Tap water for Richmond, California and New York City is monitored for strontium-90 on a monthly basis by the Atomic Energy Commission's New York Health and Safety Laboratory. The strontium-90 in tap water for the months December 1959 through March 1960 is presented below. Data for other months in 1959 were given in HASL-84, page 99.*

TABLE VIII.--STRONTIUM-90 IN TAP WATER

Richmond, California

(Approximately 40 liters per sample)

Month	$\mu\mu c$ Sr^{90}/liter	Sr^{89}/Sr^{90} at mid-point of sampling month
December 1959	0.313	0.48
January 1960	0.296	0.54
February	0.273	0.44
March	0.284	0.28

New York City

(100-200 liters per sample)

Month	$\mu\mu c$ Sr^{90}/liter	Sr^{89}/Sr^{90} at mid-point of sampling month
December 1959	0.62	0.7
January 1960	0.70	0.4
February	0.60	0.2
March	0.60	-

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*Health and Safety Laboratory Fallout Program Quarterly Summary Report, April 1, 1960, available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., for $3.50.

SECTION IV

OTHER DATA

EXTERNAL GAMMA ACTIVITY
PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variances anticipated due to differences in normal background and in instrument response characteristics.

TABLE IX.—EXTERNAL GAMMA ACTIVITY
PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Milliroentgens per hour—at three feet above the ground
For month of March 1960

Station location	Average	Station location	Average
Alaska, Anchorage	0.01	Minnesota, Minneapolis	0.01
Alaska, Fairbanks	0.01	Mississippi, Pascagoula	(*)
Alaska, Juneau	0.02	Missouri, Jefferson City	0.01
Arizona, Phoenix	0.02	Montana, Helena	0.03
Arkansas, Little Rock	0.02	New Jersey, Trenton	0.02
California, Berkeley	(*)	New Mexico, Santa Fe	0.04
California, Los Angeles	0.01	New York, Albany	0.02
Colorado, Denver	0.02	North Carolina, Gastonia	0.02
Connecticut, Hartford	0.01	Ohio, Cincinnati	(*)
District of Columbia	0.02	Oklahoma, Oklahoma City	0.02
Florida, Jacksonville	0.02	Oklahoma, Ponca City	0.04
Georgia, Atlanta	0.02	Oregon, Portland	0.02
Hawaii, Honolulu	0.02	Pennsylvania, Harrisburg	(*)
Idaho, Boise	(*)	Rhode Island, Providence	0.01
Illinois, Springfield	(*)	South Carolina, Columbia	0.02
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.01	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.01	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02

*No data received.

MEDICINE

The following article, "Radioisotopes in Medicine" appeared in the May-June 1960 issue of Research for Industry (the publication of Stanford Research Institute, Menlo Park, California). It deals with a major area of radiological health and is reproduced here by permission of Stanford Research Institute. In future issues of Radiological Health Data it is planned to include additional materials on this subject and on the fields of X-rays, as applicable to radiological Health. Contributions are most welcome.

Radioisotopes in Medicine

On August 2, 1946, the first shipment of radioisotopes for medical purposes was made by the Atomic Energy Commission. Fourteen years later, just what has been the effect of these new substances on the practice of medicine? How often and in what ways have they been used? Where? By whom? And what are the indications for future use?

The Office of Isotopes Development of the AEC sponsored a search for answers to these and other questions regarding medical usage of radioisotopes. The investigation, conducted by nuclear industrial economist Richard R. Tarrice and senior health economist Mark S. Blumberg, M.D., lasted one year and took the project team into hospitals, clinics, laboratories, and physicians' offices across the nation.

Growing Usage

In general, they found that the use of radioisotopes in medicine has become widespread. About 400,000 administrations are given to humans annually; 85 percent of these are for diagnosis. Twenty different isotopes are used, with radioiodine being by far the most common. Others commonly used include radiophosphorous, cobalt 60, and chromium 51.

An average of three out of every 1000 patients in clinics or hospitals undergo some type of diagnosis or therapy involving radioisotopes. This is about the same number as those who have fractures, appendectomies, or hernia repair. The number is more obviously significant when one considers that radioisotopes are chiefly used for relatively infrequent conditions—endocrine disorders and cancer.

Over 1,000 general hospitals in the United States offer radioisotope services, and they are also used in clinics and physicians' offices. At present over 40 percent of hospitalized persons are in institutions offering these services.

These numbers should grow. A fairly comprehensive clinical radioisotope program can be equipped for $7,000 to $10,000, which is within the range of most institutions that could make practical use of a program. Therefore, the number of institutions using radioisotopes may well triple by 1965. Further, the number of physicians trained to use these still-new tools could increase as much as fivefold in the next ten years.

The study also considered cobalt 60 teletherapy units. It was found that such units or supervoltage X-ray units are located in medical service areas that contain two-thirds of the radiation specialists and over half the population. Projections on the number of units likely to be used in the future were made on the basis of cancer and population trends.

Research and Future Uses

About 300 institutions are carrying on medical research with radioisotopes. Some 2,000 separate projects, using well over 100 different isotopes, are in progress. This represents over ten percent of all health research projects in the United States supported by the federal government or national foundations.

The coming trends in radioisotopes cannot be predicted with precision because (1) there are no historical trends to analyze, and (2) any of a number of possible future applications could grow to exceed all current uses. However, the project team noted that the volume in the United States of current uses alone could grow to 700,000 administrations a year, if urban use-rate of isotopes were to become standard for the nation as a whole. Research in the field should also increase, leading to new uses.

Current health research investigations show potential applications in conditions far more frequently encountered than those providing bases for current applications. For example, studies of insulin metabolism using radioisotope-tagged insulin may provide important clinical data on diabetes. In vitro tests with radioisotopes are being studied for determining immunity to various contagious diseases, and these might find wide application for children. Or, another example, tests with radioisotopes may contribute to diagnosis of certain mental illnesses associated with metabolic disorders.

If only one of these were to find acceptance, considerably more than 700,000 annual administrations might well be expected in coming years.

SOILS

Summary Statements on Environmental Sampling Programs

As a service to those concerned directly with the many radiation environmental sampling programs, summary statements will be published showing the organization of these programs as soon as they are completed. The fourth of these statements dealing with soil programs follows. The compilation does not purport to be complete, but does encompass most of the major efforts.

These programs are flexible in the number and location of stations, scope, duration, purpose and frequency of sampling and were designed to obtain information concerning the mechanisms of radioactive fallout rather than for environmental monitoring purposes.

Those in charge of any regularly conducted environmental sampling programs are encouraged to report both the organizational and administrative aspects of their programs, and the data derived therefrom, for possible inclusion in these monthly reports.

TABLE X.—A SELECTED LIST OF ENVIRONMENTAL

Type of sample	Operating agency	Sponsoring agency	Where sampled	Number of stations	Frequency of sampling	Year estab-lished
A. Soil	HASL, AEC	AEC	U.S.	17	Yearly through 1958	1955
B. Soil	USDA	AEC	Worldwide	87	Every 1-2 years	1956
C. Soil	USDA	AEC	Mid U.S. 32" annual rainfall sites	18	(1 year only)	1958
D. Soil	Argonne National Laboratory	AEC	Lemont, Ill. ANL	1	Monthly	1957
E. Soil	HASL-USDA Pasture site program	AEC	U.S.	6	Yearly	1953
F. Soil	USDA Chicago Milk-shed Area Survey	AEC	Chicago Milkshed Area	6	Yearly through 1958	1955
G. Soil	HASL-USDA	AEC	U.S.	62	Yearly	1959
H. Soil	HASL-USDA	AEC	West Coast U.S.	16	Yearly	1957

SAMPLING NETWORKS FOR ANALYSIS OF RADIOACTIVITY IN SOILS

Principal in charge	Radioactivity analysis				Supple-mentary analysis
	Gross radiation	Fission products	Tracers	Natural activity	
Dr. John Harley	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. P. F. Gustafson	-	Cs-137 Ru-106 Ru-103 Ce-141 Ce-144 Zr-95 Nb-95	-	Uranium, thorium and K-40	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-

SOIL NETWORKS—METHODS OF PUBLICATION OF DATA

A. Health and Safety Laboratory (AEC)—Soil.

HASL-42 "Environmental Contamination From Weapons Tests," Oct 1958.

HASL-55 AEC "Strontium Program, Quarterly Summary Report," Feb. 2, 1959.

HASL-65 AEC "Strontium Program, Quarterly Summary Report," May 29, 1959.

HASL-69 AEC "Strontium Program, Quarterly Summary Report," Oct. 1, 1959.

HASL-77 AEC "Strontium Program, Quarterly Summary Report," Jan. 1, 1960.

HASL-84 AEC "Fallout Program, Quarterly Summary Report," April 1960. AEC Quarterly Statements on Fallout.

"Measurement of Strontium-90 in Geophysical and Biological Materials." Eisenbud, M. Statement to Joint Committee on Atomic Energy Hearings on Fallout, May 1957. Vol. 1, p. 554.

"Summary of Analytical Results from the HASL Strontium Program July Through December, 1956." Harley, J. H., Hardy, E. P. Jr., Whitney, I. B. and Eisenbud, M. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1957. Vol. 1, p. 591.

"Strontium-90 Distribution as Determined by the Analysis of Soils." Alexander, L. T. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959. Vol. 1, p. 278.

"Data on the Deposition of Strontium-90 During 1958." Harley, J. H., Hardy, E. P. Jr., Klein, S. and Lough S. A. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959. Vol. 1, p. 373.

"Deposition of Strontium-90 Through October 1958." Eisenbud, M. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959. Vol. 1, p. 907.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90", L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

B. U. S. Department of Agriculture—Atomic Energy Commission Worldwide Soil.

HASL-42 Environmental Contamination From Weapons Tests, Oct. 1958.

HASL-55 AEC Strontium Program, Quarterly Summary Report, Feb. 2, 1959.

HASL-65 AEC Strontium Program, Quarterly Summary Report, May 29, 1959.

HASL-69 AEC Strontium Program, Quarterly Summary Report, Oct. 1, 1959.

HASL-77 AEC Strontium Program, Quarterly Summary Report, Jan. 1, 1960.

HASL-84 AEC Fallout Program, Quarterly Summary Report, April, 1960. AEC Quarterly Statements on Fallout.

Strontium-90 Distribution as Determined by the Analysis of Soils. By L. T. Alexander. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959, Vol. I, page 278.

Measurement of Strontium-90 in Geophysical and Biological Material, By M. Eisenbud. Statement to Joint Committee on Atomic Energy Hearings on Fallout, May 1957, Vol. I, page 554.

Summary of Analytical Results from the HASL Strontium Program July Through December, 1956, By J. M. Harley, E. P. Hardy, Jr., I. S. Whitney and M. Eisenbud. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1957, Vol. I, page 591.

Data on the Deposition of Strontium-90 During 1958, By J. H. Harley, E. P. Hardy, Jr., S. Klein and S. A. Lough. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90" L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

C. U. S. Department of Agriculture.

(Strontium-90 Values Along a Mid-continental 32-inch Precipitation Transect)

Strontium-90 Distribution as Determined by the Analysis of Soils, by L. T. Alexander. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959, Vol. I, page 278.

HASL-65 AEC Strontium Program, Quarterly Summary Report, May 29, 1959.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90" L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

D. Argonne National Laboratory—Atomic Energy Commission

ANL-6049, Argonne National Laboratory, Radiological Physics Division, Semiannual Report, January through June 1959, October, 1959.

ANL-5919, Argonne National Laboratory, Radiological Physics Division, Semiannual Report, January through June 1958, September 1958.

ANL-5967, Argonne National Laboratory, Radiological Physics Division, Semiannual Report, July through December 1958, May 1959.

P. F. Gustafson, "Ratio of Cesium-137 and Strontium-90 Radioactivity in Soil," Science, 130, 3386, 1404-5 (20 Nov. 1959).

Appendix to the Statement of Dr. Austin M. Brues, Hearings before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy, May 1959, Vol. 2, page 1400.

E. U. S. Department of Agriculture—Atomic Energy Commission—Pasture Program.

Summary of Analytical Results From the HASL Strontium Program July Through December, 1956, by J. H. Harley, E. P. Hardy, Jr., I. B. Whitney and M. Eisenbud. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1957, page 591.

HASL-42 AEC Environmental Contamination from Weapons Tests, Oct., 1958.

F. Chicago Milkshed Soils (1955)

Project Sunshine Bulletin, No. 12: Strontium-90 Concentration Data for Biological Materials, Soils, Waters and Air Filters. E. A. Martell, August 1, 1956.

HASL-42 AEC Environmental Contamination from Weapons Tests, Oct., 1958.

G. U. S. Department of Agriculture—Health and Safety Laboratory (State Sites—1959)

"Strontium-90 Distribution as Determined by the Analysis of Soils," Alexander, L. T. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959, Vol. I, p. 278.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90," L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

HASL-65 AEC "Strontium Program, Quarterly Summary Report," May 1959.

HASL-69 AEC "Strontium Program, Quarterly Summary Report," October 1959.

H. U. S. Department of Agriculture—Health and Safety Laboratory (West Coast Rainfall Study)

SOIL NETWORKS—SAMPLING STATION LOCATIONS

A. Health and Safety Laboratory--Atomic Energy Commission Soil Samples
(Discontinued in 1959)

Seattle, Washington	Des Moines, Iowa	Albuquerque, New Mexico
Rapid City, South Dakota	Salt Lake City, Utah	Atlanta, Georgia
Boise, Idaho	New York, New York	Los Angeles, California
Rochester, New York	Philadelphia, Pennsylvania	New Orleans, Louisiana
Detroit, Michigan	Grand Junction, Colorado	Jacksonville, Florida
Binghamton, New York	Memphis, Tennessee	

Note: This sampling program merged in 1959 with the program described under section G to obtain coverage of all the states.

B. U. S. Department of Agriculture Worldwide Soil Samples

Hawaii-Oahu, Kawailoa Girls' School
Hawaii-Oahu, Leilehua Golf Course
Hawaii-Oahu, Kahuku
Hawaii-Oahu, Wahiawa, Mauka Intake
Canton Island, near air strip
Canton Island, near lighthouse
Wake Island
Campbell Island
Bermuda—Hamilton
Japan—Tokyo
Japan—Sapporo
Japan—Fukuoka
Philippines—Manila
Singapore
India—Calcutta
Pakistan—Karachi
Aden
United Arab Republic—Damascus
Lebanon—Beirut
Turkey—Ankara
Senegal—Dakar
Senegal—Hann
Kenya—Kikuyu
Southern Rhodesia—Salisbury
Union of South Africa—Durban
Belgian Congo—Leopoldville
Italy—Florence
France—Paris
Norway—Oslo
Norway—Lake Finse
Norway—Bodo
Norway—Bergen
Norway—Bardufoss
Norway—Vadso
Norway—Ekkerow
Iceland—Reykjavik
Panama—Fort Amador, Canal Zone
Panama—Fort Clayton, Canal Zone
Venezuela—Caracas
Puerto Rico—San Juan
Colombia—Bogota
Peru—Lima
Peru—Huancayo
Chile—Santiago
Chile—Antofagasta
Chile—Punta Arenas
Argentina—Buenos Aires
Paraguay—Asuncion
Brazil—Sao Paulo
Brazil—Belem
Brazil—Belem, Institute
Australia—Adelaide
Australia—Brisbane
Australia—Katherine
Australia—Perth
Australia—Alice Springs
Tasmania—Hobart
New Zealand—South Canterbury
New Zealand—North Auckland
New Zealand—Wellington
Canada—Ottawa, Ontario
Canada—Saanichton, British Columbia
Canada—Lacombe, Alberta
Canada—Agassiz, British Columbia
Canada—Aklavik
Canada—Fort Simpson
Canada—Chimo
Canada—Kentville, Nova Scotia
Canada—Ellesmere Island
Canada—Cornwallis Island
Canada—St. Johns, Newfoundland
Alaska—Fairbanks
Alaska—Palmer
Alaska—Point Barrow

C. U. S. Department of Agriculture Sites Having Average Annual Rainfall of 32 Inches. (1958)

Danevang, Texas	Slidell, Texas	Springfield, Illinois*
Brenham, Texas	Marlow, Oklahoma	Galva, Illinois
Dime Box, Texas	Chandler, Oklahoma	Marengo, Illinois
Thornton, Texas	Tulsa, Oklahoma *	Portage, Wisconsin
Ferris, Texas	Bolivar, Missouri	Antigo, Wisconsin
Sanger, Texas	Columbia, Missouri*	Ontonagon, Michigan

* These locations were sampled in 1959 also.

D. Argonne National Laboratory

Lemont, Illinois

E. Health and Safety Laboratory—Pasture Program—Soil

Tifton, Georgia
New Brunswick, New Jersey
Raleigh, North Carolina
Ithaca, New York
Logan, Utah (College Farm)
Mandan, North Dakota
Brawley, California

F. Chicago Pasture Site Survey—Soil

Will County, Illinois (Van Winkle Farm—Carver Farm)
Columbia County, Wisconsin—(Premo Farm)
Rock County, Wisconsin (Holcomb Farm—Grabow Farm—Swain Farm)
Dane County, Wisconsin (Lewke Farm)
Winnebago County, Illinois (Swanson Farm)
McHenry County, Illinois (Kurpeski Farm—Austin Farm—McKee Farm)

G. U. S. Department of Agriculture--Health and Safety Laboratory (State Sites--1959)

Alabama, Birmingham
Arizona, Tucson
Arkansas, Little Rock
California, Los Angeles
California, Healdsburg
Colorado, Derby
Connecticut, Windsor
Delaware, Newark
Florida, Jacksonville
Georgia, Atlanta
Idaho, Boise
Illinois, Springfield
Indiana, W. Lafayette
Iowa, Des Moines
Kansas, Manhattan
Kentucky, Lexington
Louisiana, Alexandria
Maine, Orono
Massachusetts, Amherst
Massachusetts, S. Wellfleet
Michigan, Detroit
Minnesota, St. Paul
Mississippi, Newton
Missouri, Columbia
Montana, Bozeman
Nebraska, Lincoln
New Hampshire, Durham
New Jersey, New Brunswick
New York, Rochester
New York, Binghamton
New York, New York
North Carolina, Raleigh
North Dakota, Mandan
Ohio, Columbus
Oklahoma, Tulsa
Oregon, Corvallis
Oregon, Glendale
Pennsylvania, State College
Rhode Island, Kingston
South Carolina, Clemson
South Dakota, Rapid City
Tennessee, Knoxville
Texas, Waco
Utah, Salt Lake City
Vermont, Burlington
Virginia, Blacksburg
Washington, Puyallup
Washington, Clallam Bay
Washington, Sequim
Washington, Port Angeles
Washington, Joyce
Washington, Forks
Washington, Longview
West Virginia, Morgantown
Wisconsin, Madison
Alaska, Point Barrow
Alaska, Fairbanks
Alaska, Palmer
Hawaii, Oahu (4)

H. U. S. Department of Agriculture--Health and Safety Laboratory--West Coast Rainfall Study

Courtenay, B. C.
Douglas, B. C.
Sequim, Washington
Port Angeles, Washington
Clallam Bay, Washington
Joyce, Washington
Forks, Washington
Puyallup, Washington
Longview, Washington
Corvallis, Oregon
Glendale, Oregon
Sayers Bar, California*
Healdsburg, California
Big Sur, California*
Big Bear City, California*
Cuyamaca, California*

Note: This group of sites was established in 1957 except for Clallam Bay which was first sampled in 1959. Starred sites were not sampled in 1959 due to loss of the site by cultivation or rodent damage.

FOOD CONSUMPTION OF HOUSEHOLDS IN THE UNITED STATES

As a necessary step in the evaluation of the radiological health aspects of radioactivity in foods, there must be estimates of the kinds and amounts of food consumed. The Department of Agriculture is preparing five sets of estimates of food consumption in the United States, the first of which deals with the country as a whole. The others have to do with the estimates for the following regions: Northeast, North Central, South, and West.

The first set of estimates has been completed and is reproduced in this issue for use by scientists in the fields of nutrition and radiological health. Values for calcium intake are included in the table of "Food Consumption of Households in the United States," for use when evaluating the intake of such radionuclides as strontium-90. The values of calcium will not be included in the tables of food consumption in other regions, which data will appear in subsequent issues of Radiological Health Data.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Household Economics Research Division
Washington 25, D. C.

The following table showing average "per person quantities" of foods used per week (in pounds) and per day (in grams), has been derived from data in "Household Food Consumption Survey," 1955, Report No. 1, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at $1.25.

Averages are for foods used at home during a week in the spring, as brought into the household, and are based on all housekeeping households in the nation. "Per person quantities" were computed by dividing "household quantities" by the "average household size" (3.33 persons for the United States as a whole). "Average household size" was derived by dividing by 21 the total number of meals served during the survey week from family food supplies.

For some purposes, information on the consumption of those actually using a given food is more useful than averages based on all persons. An approximate but not precise figure can be computed from these data. Information was obtained in the survey only on household use—not on the individual member use of foods. Estimated quantity of food per person may be obtained by dividing the "quantities used per person per week" based on all households by the "percentage of households using" shown in column 2. For example, the estimate of the average per-person use of commercially baked white bread per week in households is 1.39 pounds, derived by dividing 1.20 from the third column by 86.1 shown in the second column, page 28. Such an estimate understates the value for those actually using the food, since it is not reasonable to assume that all members of all households reporting use of the food actually used some of the item. The understatement is probably small for such items as bread, sugar, etc., that in many households are likely to be eaten by every member, but it may be considerable for items such as tea, coffee, or baby foods that are less likely to be used by all members.

The estimate of the quantity per person using an item computed from this table will also be understated when the average size of household utilizing food is smaller than the average of all households. The average size of households using lamb and mutton, for example, is approximately 3.07 instead of 3.33 persons (all U. S.) and the average per person per week in households using is 0.84 pounds rather than the 0.77 pounds computed from the figures in this table.

On the other hand, the estimated average computed from this table will be overstated when the average size of the households using is larger than that of all households. This is true for example, for such items as ice cream (3.55 persons) and breakfast cereals (3.48 persons).

While estimates computed from these data will provide an indication of the importance of an item in the individual diet, they do not show the maximum likely to be used, such as would be shown by the percentage distribution using specified amounts per person. Also, since the averages for those using the items are not additive, combinations of items cannot be easily estimated.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE

Food	Households using	Quantity per person		Calcium per person per day
		In a week	Per day	
(1)	(2)	(3)	(4)	(5)
	Percent	Pounds	Grams	Milligrams
Milk, cream, ice cream, cheese (fluid milk equivalent[1]	99.6	9.56	620	733
Fresh fluid milk, total	93.6	7.14	463	548
Whole	90.5	6.46	419	495
Buttermilk	18.7	.38	24	30
Skim	5.9	.19	12	15
Chocolate (commercial)	5.4	.08	5	5
Half and half, extra rich	6.9	.04	3	3
Processed milk:				
Evaporated	35.1	.29	19	46
Condensed	2.3	.02	1	3
Dry, total	12.1	.03	2	20
Nonfat	7.2	.02	1	15
Whole	2.4	.01	(*)	4
Products, nonfat and whole[2]	3.1	.01	(*)	1
Cream, total[3]	24.0	.09	6	5
Light	7.2	.03	2	2
Heavy, whipped, whip topping	17.4	.06	4	3
Ice cream, ice milk (commercial)[4]	57.7	.37	24	29
Cheese, total	77.9	.32	21	82
Cottage	34.9	.13	8	5
Nonprocessed, total[5]	32.5	.07	5	28
American-type	16.4	.04	3	20
Swiss	3.8	.01	(*)	4
Cream	10.8	.02	1	1
Other	6.2	.01	1	3
Processed, total[6]	48.9	.12	8	49
American, Swiss, cream, other	43.0	.10	7	45
Cheese spreads	8.5	.01	1	3
Fats and oils, total	99.5	.89	58	7
Table fats, total	96.8	.40	26	6
Butter	59.7	.20	13	3
Margarine	58.1	.20	13	3
Shortening, total	71.7	.28	18	0
Lard[7]	26.3	.14	9	0
Other	49.6	.14	9	0
Salad and cooking oils	23.5	.06	4	0
Salad dressings (commercial), total	69.1	.15	10	1
Mayonnaise and mayonnaise-type	41.4	.07	4	1
French and french-type	16.0	.02	1	0
Other[8]	24.5	.07	4	(*)

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.
[1] Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.
[2] Chiefly dry cocoa mixes.
[3] Includes small amounts of powdered cream, not shown separately.
[4] Includes frozen custard and frozen desserts with vegetable fats.
[5] Includes quantities of cheese for which respondent could not report whether or not processed.
[6] Includes small amounts of cheese food, not shown separately.
[7] Includes small amounts of chicken fat.
[8] Includes sandwich spreads.

TABLE XI.–FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955–U. S. DEPARTMENT OF AGRICULTURE--Con.

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Flour and other cereal products, total	97.5	1.76	114	87
Flour other than mixes, total	79.2	.80	52	47
White	79.0	.79	51	47
Other	1.8	.01	1	(*)
Prepared flour mixes, total	38.8	.18	12	23
Pancake	13.7	.04	3	12
Cake	19.4	.09	6	4
Biscuit, roll, muffin	11.6	.04	2	6
Other	7.6	.02	1	1
Breakfast cereals (excluding baby cereals), total	75.4	.25	16	5
Ready-to-eat, total	64.9	.17	11	3
Corn flakes	36.9	.07	4	(*)
Wheat, flaked, puffed, shredded	32.9	.06	4	2
Rice, flaked, puffed, etc	15.1	.02	1	(*)
Other	14.2	.02	1	1
Hot, total[9]	30.7	.08	5	2
Rolled oats, oatmeal	25.0	.06	4	2
Wheat cereals	9.5	.02	1	(*)
Other cereals, total	73.7	.53	35	12
Baby cereals	7.4	.01	1	3
Rice	28.2	.09	6	1
Cornmeal, grits, total	26.4	.28	18	6
Cornmeal	24.4	.24	16	6
Hominy grits	7.6	.03	2	(*)
Hominy (big)	2.3	.01	1	(*)
Macaroni, spaghetti, noodles	42.3	.13	8	2
Popcorn	8.1	.02	1	(*)
Other[10]	11.4	.01	(*)	(*)
Bakery products, total	97.3	2.01	130	98
Bread, total	94.0	1.41	92	74
White[11]	86.1	1.20	77	61
Whole wheat	16.2	.09	6	6
Other	26.9	.13	8	7
Baked goods other than bread, total	82.5	.60	39	24
Crackers, total	54.6	.14	9	1
Sweet	12.1	.03	2	(*)
Not sweet	50.0	.11	7	1
Rolls, total	20.4	.06	4	2
Ready-to-eat	12.5	.04	2	1
Brown and serve	8.8	.03	2	1
Biscuits, muffins	8.4	.03	2	4
Cakes	22.4	.11	7	8
Pies	10.7	.06	4	1
Other[12]	49.6	.20	13	8

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.
[9] Includes small amounts of other hot cereals not shown separately.
[10] Includes tapioca, cornstarch, barley, buckwheat grits.
[11] Practically all reported as enriched.
[12] Includes cookies, doughnuts, sweet buns, coffee cake, etc.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Eggs	97.9	0.84	55	26
Meat, poultry, fish, total	99.5	4.14	268	32
Meat, total	99.3	3.03	197	18
Beef, total	88.7	1.25	81	8
Steak, fresh, frozen, total	52.1	.39	25	2
Round	26.6	.17	11	1
Other	32.5	.22	14	1
Roast, fresh, frozen, total	32.0	.35	22	2
Rib	7.1	.08	5	(*)
Other	25.6	.27	17	2
Stewing, boiling, fresh, frozen	18.8	.11	7	1
Corned, chipped, dried	6.9	.02	1	(*)
Ground, fresh, frozen	61.6	.38	24	3
Canned (commercial)	3.2	(*)	1	(*)
Veal, total[13]	12.6	.08	5	(*)
Roast, shoulder, fresh, frozen	2.6	.02	2	(*)
Chops, cutlets, fresh, frozen	9.3	.05	3	(*)
Pork, total	90.0	1.14	74	7
Fresh, frozen, total	55.7	.49	32	3
Chops	34.2	.19	12	1
Ham	4.3	.04	3	(*)
Loin	7.6	.08	5	1
Sausage	20.6	.09	6	
Other	11.8	.10	6	1
Cured, smoked, total	81.4	.63	41	4
Ham, raw, precooked	31.9	.26	17	1
Bacon	66.8	.25	16	2
Salt pork	12.3	.05	4	0
Other	11.6	.07	4	1
Canned (commercial)	2.3	.02	2	(*)
Lamb, mutton, total	11.6	.09	6	(*)
Chops, steak, fresh, frozen	7.6	.04	3	(*)
Roast, shoulder, leg, fresh, frozen	3.2	.04	3	(*)
Stewing, soup, ground, patties	1.3	.01	(*)	(*)
Variety meats and game, total	23.6	.11	7	1
Liver	19.0	.07	4	1
Other[14]	6.3	.04	3	
Luncheon meats, total	69.2	.36	24	2
Frankfurters	39.0	.15	10	1
Other, total	55.9	.22	14	1
Canned	6.2	.02	1	(*)
Other	53.0	.20	13	1
Poultry, total[15]	55.2	.71	46	5
Chicken[16]	53.2	.63	41	4
Turkey[16]	2.5	.06	4	1

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.
[13] Includes small amounts of other veal, not shown separately.
[14] Includes tongue, kidney, heart, tripe, etc.; game.
[15] Includes small amounts of other poultry, not shown separately.
[16] Chiefly fresh or frozen, only small amounts of canned reported.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person In a week (3)	Quantity per person Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Meat, poultry, fish—Con.				
Fish and shellfish, total	63.1	0.40	26	9
Fish, total[17]	58.8	.34	22	8
Canned (commercial), total	35.0	.09	6	6
Salmon	12.7	.04	2	6
Tuna	21.5	.04	2	(*)
Other[18]	5.4	.01	1	(*)
Fresh, frozen	33.2	.25	16	2
Shellfish, fresh, frozen, canned	11.8	.06	4	1
Sugar, sweets, total	97.5	1.25	81	14
Sugar, total	94.8	.83	54	1
White, total	94.6	.80	52	0
Granulated	94.4	.74	48	0
Confectioners, powdered	17.7	.05	4	0
Brown	14.0	.03	2	1
Sirups, molasses, honey, total	37.3	.13	8	4
Sirups, total	29.5	.10	7	2
Corn, cane	14.3	.06	4	1
Maple, sorghum, other[19]	16.3	.05	3	1
Molasses	4.3	.01	1	2
Honey	7.2	.02	1	(*)
Jellies, jams, total	62.8	.18	11	2
Jellies	36.7	.08	5	1
Jams, preserves, fruit butters, etc.	35.1	.09	6	1
Candies (commercial), total	40.0	.11	7	7
With nuts	13.9	.03	2	4
Without nuts	30.6	.08	5	3
Potatoes, sweetpotatoes, total	93.0	1.87	121	12
Fresh, total	91.6	1.80	117	11
White	90.9	1.75	113	10
Sweetpotatoes	8.0	.06	4	1
Frozen[20]	4.3	.01	1	(*)
Canned, dehydrated[21]	3.9	.02	1	(*)
Potato chips and sticks[22]	20.2	.04	2	1
Fresh vegetables, total[23]	98.1	2.66	172	57
Dark green and deep yellow, total[24]	69.4	.42	27	23
Dark green leafy, total	26.6	.16	10	16
Spinach	8.2	.03	2	1
Other	20.8	.12	8	15
Broccoli	4.6	.03	2	3
Carrots	51.5	.20	13	4
Peppers, green	21.0	.03	2	(*)

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[17] Includes small amounts of smoked, cured fish, not shown separately.

[18] May include small amount of ready-cooked fish, not canned.

[19] See page 33 for chocolate sirup.

[20] Chiefly french fried.

[21] Chiefly canned sweetpotatoes.

[22] Chiefly chips.

[23] Includes home canned and frozen vegetables that were brought into the home in fresh form.

[24] Includes other dark green and deep yellow vegetables not shown separately.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	House-holds using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Fresh vegetables—Con.				
Other green, total	88.9	1.05	68	21
Asparagus	16.5	.10	6	1
Beans, snap, wax	28.7	.18	12	7
Cabbage	37.4	.30	19	7
Lettuce	72.1	.36	23	4
Peas	8.7	.05	4	1
Other	8.7	.05	3	1
Tomatoes	62.0	.35	23	2
Other than tomatoes and green and deep yellow, total	90.4	.84	54	11
Celery	42.1	.12	8	3
Cucumbers	22.9	.08	5	(*)
Mature onions	65.7	.23	15	4
Green onions	26.9	.07	4	2
Other, total[25]	48.8	.35	23	2
Corn	18.5	.16	11	(*)
Fresh fruits, total[26]	91.3	2.86	185	23
Citrus, total[27]	66.2	1.17	76	12
Grapefruit	25.5	.34	22	2
Lemons, limes[28]	28.8	.10	6	(*)
Oranges	45.5	.73	47	10
Other than citrus, total[29]	83.9	1.69	110	11
Apples	44.0	.39	25	1
Bananas	56.2	.44	28	2
Melons	13.2	.34	22	2
Rhubarb	9.1	.06	4	1
Strawberries	20.6	.17	11	3
Avocados	5.3	.02	1	(*)
Berries other than strawberries	6.3	.04	3	1
Cherries	6.0	.04	2	(*)
Peaches	11.5	.09	6	(*)
Other	12.7	.10	6	1
Commercially frozen fruits and vegetables	34.9	.17	11	6
Fruits[30]	9.6	.03	2	(*)
Vegetables other than potatoes, total	30.2	.14	9	6
Beans, lima	7.7	.02	1	1
Beans, snap, wax	6.0	.02	1	1
Broccoli	7.5	.02	1	1
Peas	11.6	.03	2	(*)
Spinach	5.0	.01	1	1
Corn	3.5	.01	1	(*)
Other	11.5	.03	2	2

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.
25 Includes beets, cauliflower, turnips, rutabagas, and others not shown separately.
26 Includes home canned and frozen fruits that were brought into the home in fresh form.
27 Includes small amounts of tangerines and kumquats not shown separately.
28 Chiefly lemons.
29 Includes small amounts of figs and grapes not included in "Other."
30 Chiefly strawberries.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food	Households using	Quantity per person		Calcium per person per day
		In a week	Per day	
(1)	(2)	(3)	(4)	(5)
	Percent	Pounds	Grams	Milligrams
Commercially canned fruits and vegetables, total..	84.1	1.23	80	11
Fruits, except baby and junior foods, total	52.7	41	27	1
Apples, applesauce	15.4	.07	4	(*)
Apricots	4.4	.02	1	(*)
Berries	3.9	.01	1	(*)
Cherries	6.0	.02	1	(*)
Peaches	21.1	.12	8	(*)
Pears	9.5	.04	3	(*)
Pineapple	16.0	.06	4	1
Plums, prunes	1.8	.01	1	(*)
Mixed fruit, fruit cocktail	10.2	.05	3	(*)
Other	4.5	.02	1	(*)
Baby, junior foods, incl. juices	8.3	.04	3	(*)
Vegetables, except baby and junior foods, total[31]	73.7	.75	49	9
Asparagus	5.9	.02	1	(*)
Baked beans, or other mature beans	13.9	.07	5	2
Beans, lima, green, immature	5.1	.02	1	(*)
Beans, snap, wax	23.5	.11	7	2
Beets	11.1	.04	2	(*)
Corn	29.7	.13	9	(*)
Peas, green, immature	32.1	.14	9	2
Tomatoes, total	24.2	.12	8	1
Pulp	15.5	.09	6	1
Puree, paste	12.2	.03	2	(*)
Other	25.2	.10	7	2
Baby, junior foods, incl. potatoes	5.8	.02	2	1
Fruit and vegetable juices, fresh, frozen, canned, powdered[32, 33]	60.7	1.05	68	7
Canned citrus, total[32, 34]	21.5	.28	18	1
Orange	12.3	.17	11	1
Grapefruit	7.4	.07	5	(*)
Canned fruit other than citrus[32]	19.2	.17	11	2
Canned tomato and other vegetable juices[32, 35]	22.3	.18	12	1
Frozen, concentrated, total	23.5	.11	7	
Orange	21.1	.09	6	2
Other	5.0	.01	1	1
Fresh (commercial)	2.9	.04	2	
Dried fruits and vegetables, total[36]	43.0	.18	12	13
Dried fruit, total	20.5	.05	4	2
Prunes	8.2	.02	2	1
Raisins, currants	11.0	.02	1	1
Other	4.5	.01	1	(*)

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.
[31] Includes small amount of mature peas not included in "Other."
[32] Single strength equivalent.
[33] Does not include baby or junior juices. See above.
[34] Includes orange and grapefruit blend and other citrus juices not shown separately.
[35] Includes both commercially and home-canned and frozen juices.
[36] Includes both commercially and home-dried fruits and vegetables.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Dried fruits and vegetables—Con.				
Dry vegetables, total	28.8	0.13	8	11
Beans, total	25.1	.11	7	10
Lima	7.7	.03	2	1
Navy, pinto, kidney, other	19.3	.08	5	9
Peas, lentils, other	6.4	.02	1	1
Beverages:				
Coffee, total[37]	91.2	.24	16	0
Bean, ground	74.1	.23	15	0
Instant, powdered	22.7	.01	1	0
Substitute	3.3	(*)	(*)	0
Tea[38]	26.2	.03	2	0
Chocolate, cocoa, chocolate sirup, total	23.9	.03	2	1
Chocolate	6.0	.01	(*)	(*)
Cocoa	15.8	.01	1	1
Chocolate sirup	3.5	.01	1	(*)
Soft drinks, fruit ades, total	59.2	.90	58	(*)
Soft drinks, bottled and canned, total	53.1	.87	56	0
Cola-type	35.5	.54	35	0
Fruit flavored	11.5	.14	9	0
Other	17.3	.19	12	0
Powdered	7.8	.01	(*)	0
Fruit ades, total	6.7	.03	2	(*)
Frozen	4.5	.01	1	(*)
Other	2.3	.02	1	(*)
Miscellaneous foods:				
Nuts (shelled weight) and peanut butter, total	46.0	.09	6	5
Nuts (shelled weight), total	19.5	.03	2	2
Peanuts	6.8	.01	1	1
Other	14.0	.02	1	1
Peanut butter	34.6	.06	4	3
Soups, except canned baby soups, total	42.7	.21	14	4
Vegetable, total	29.0	.12	8	2
Condensed	25.4	.11	7	2
Other	3.6	.01	(*)	(*)
Meat, fish, grain, total	24.1	.09	6	2
Condensed	20.8	.09	6	2
Other	4.3	.01	1	(*)
Catsup, chili sauce, etc., total[39]	47.8	.11	7	1
Catsup	40.3	.07	4	1
Chili sauce	3.6	.01	(*)	(*)
Barbecue sauce, etc.	9.7	.03	2	(*)
Tomato relishes	2.8	.01	(*)	(*)
Pickles, olives, relishes, total[39]	43.0	.14	9	3
Pickles	34.8	.12	8	2
Olives	12.4	.02	1	1
Relishes other than tomato	5.4	.01	1	(*)

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.
37 Includes small amounts of liquid concentrate coffee, not shown separately.
38 Data refer to amounts bought during the 7-day survey period rather than the amounts used.
39 Includes both commercial and homemade products.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food	Households using	Quantity per person		Calcium per person per day
		In a week	Per day	
(1)	(2)	(3)	(4)	(5)
	Percent	Pounds	Grams	Milligrams
Miscellaneous foods—Con.				
Puddings, pie fillings, miscellaneous sweets (commercial), total[40]	40.7	0.08	5	1
Puddings, pie fillings[41]	34.6	.05	3	(*)
Strained canned puddings (baby)	3.4	.01	1	(*)
Sherbets, ices	5.7	.02	1	1
Icing mix, fudge mix	2.6	.01	(*)	(*)
Other mixtures, prepared or partially prepared, total	32.3	.18	12	3
Mixtures other than baby, junior foods, total	28.2	.15	10	3
Without meat[42]	11.5	.05	3	1
With meat[43]	20.3	.10	7	2
Baby, junior foods, total	6.7	.03	2	(*)
Meat, mixtures with meat	6.3	.03	2	(*)
Without meat	1.9	(*)	(*)	(*)
Leavening agents, total[44]	18.6	.03	2	(*)
Yeast	8.1	(*)	(*)	(*)
Other[44]	11.7	.03	2	0
Seasonings:[44]				
Vinegar	10.3	.06	4	0
Salt	22.3	.11	7	0

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[40] Includes other miscellaneous sweets not shown separately.

[41] Chiefly dry, including plain gelatin.

[42] Includes spaghetti with tomato sauce, potato salad, cole slaw, macaroni and cheese dinners, chow mein and chop suey dinners, and others.

[43] Includes poultry and meat pies, spaghetti with meat balls, corned beef hash, chili con carne, ravioli, tamales, and others.

[44] Data refer to amount bought during the 7-day survey period rather than the amounts used.

SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH

The following summary of state activities in radiological health are included as an informational service to those in this field of work. Any corrections and/or comments are solicited. Further reporting of state activities in radiological health is planned for future issues of Radiological Health Data. Contributions from the states are most welcome.

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH

		Alabama 4-5-60	Alaska 6-15-60	Arizona 3-28-60	Arkansas 6-15-60	California 6-15-60	Colorada 5-13-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	Yes—model APHA Rad. Protection Act, without Commission, eff. 3-18-57	No (proposed)	Yes—model APHA Radiation Protection Act, without Commission; by authority House Bill 413, eff. 6-11-59	Limited—(coverage of waste disposal)	Yes—by authority House Bill 104, eff. 3-13-57 (not model APHA RPA)
RADIATION CODE or REGULATIONS		No (proposed)	No (proposed)	No	No	Limited—General Industry Safety Order Resolution 88, eff. 1-25-57	Yes—eff. 10-12-59 (based on Handbook 61)
REGISTRATION of RADIATION SOURCES REQUIRED		No	Yes	No (proposed)	Yes—(see Enabling Act)	Yes	Yes—by authity House Bill 140, eff. 2-10-58
SHOE FITTING FLUOROSCOPES	REGULATED	No		No		1959. Yes—by authority of Chapter 362	No
	BANNED	No	Yes	No	Yes—by authority Act No. 133, Laws of 1959 app. 3-3-59		No
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Nuclear Advisory Committee	Yes—by authority House Bill 49, Sec. 5, eff. 4-27-59	No (proposed)	Yes—by authority House Bill 853, eff. 3-27-57	Yes—effective 8-1-59	No
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No		No	No		Yes
REMARKS		Programs inventoried 7-15-59	Programs inventoried 5-20-59	Programs inventoried 5-25-59	Programs inventoried 7-22-58	Programs inventoried 7-22-58	Programs inventoried 7-24-58

APHA RPA—American Public Health Association, Radiation Protection Act.

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Connecticut 6-20-60	Delaware 6-15-60	District of Columbia 6-15-60	Florida 4-4-60	Georgia 3-15-60	Hawaii 3-18-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—by authority of Sec. 19-24 of the 1958 Revision of State Statutes (not a model APHA RPA)	No	No	Yes—by authority of State Statutes of 1955 Chap. 381 and 387 which provide for Environmental Hlth. Codes, Rules and Regulations (not a model APHA RPA)	No	Yes
RADIATION CODE or REGULATIONS		Yes—by authority of the State Sanitary Code, Regulation 287 and Gen. Statutes	Yes	No	No (proposed)	No—(have a Water Control Act, Sec. 6, Para. A, eff. 3-17-57 which provides for limited regulation)	No (proposed)
REGISTRATION of RADIATION SOURCES REQUIRED		Yes—by authority of Sec. 19-24 and 19-2512-55 of the 1958 Revision of State Statutes	Yes—eff. 12-55	No (proposed)	No (proposed)	No	Yes
SHOE FITTING FLUORO-SCOPES	REGULATED	No	No	Yes	Yes	Yes 1-52	No
	BANNED	Yes—by authority of Sec. 53-212a of the 1958 Revision of Statutes	Yes—eff. 3-1-58	No	No	No	No (proposed)
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—by authority of Sec. 19-49 of the 1958 Rev. of Statutes	No	No	Nuclear Development Commission	Yes—Nuclear Advisory Commission	No (proposed)
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	No	No	No	Yes—Advisory Committee on Radiological Health
REMARKS					Programs inventoried 5-25-59	Programs inventoried 7-17-58	Programs inventoried 5-59

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Idaho 5-13-60	Illinois 6-16-60	Indiana 6-16-60	Iowa 6-16-60	Kansas 6-16-60	Kentucky 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	Yes—model APHA Radiation Protection Act, eff. 7-17-59	Yes—model APHA Radiation Protection Act as authorized by State Acts of 1959, Chap. 77, eff. 7-21-59	No (proposed)	Yes--by authority of House Bill 376, eff. 7-1-59 (not model APHA RPA)	No
RADIATION CODE or REGULATIONS		Yes--eff. 8-4-58	No (proposed)	No	No	No	Yes--by authority of Revised State Statutes, eff. 9-23-59
REGISTRATION of RADIATION SOURCES REQUIRED		Yes—(other than Healing Arts)	Yes—effective 7-5-57	Yes	No (proposed)	Yes--(see Enabling Act)	Yes--by authority of Revised State Statutes eff. 9-23-59
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	No	No	No	
	BANNED	No	Yes	Yes--eff. 7-21-59	No	Yes--eff. 9-12-58	
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—Governor's Committee	Yes—Commission	No	No	Yes--by authority of House Bill 175	
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No (Ad Hoc Committees)	Yes	Yes--Advisory Commission as authorized by Senate Bill 200	No	Yes--Advisory Council	
REMARKS		Programs inventoried 2-10-59	Programs inventoried 6-16-59				

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Louisiana 6-16-60	Maine 6-16-60	Maryland 6-16-60	Massachusetts 6-16-60	Michigan 6-16-60	Minnesota 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	No	No (proposed)	Yes—by authority of House Bill 2650, eff. 12-30-58 (not model APHA RPA)	Yes--by authority of House Bills 303 and 243, eff. 1-1-59 (not model APHA RPA)	Yes—by authority of Chap. 361 of 1957, eff. 4-11-57
RADIATION CODE or REGULATIONS		No	No	No	Yes—by authority of Chap. 453 1957, eff. 6-21-57	Yes	Yes
REGISTRATION of RADIATION SOURCES REQUIRED		No	Yes--by authority of State Regulations eff. 12-30-58	No (proposed)	Yes	Yes	Yes
SHOE FITTING FLUORO-SCOPES	REGULATED	No	No	No		Yes	No
	BANNED	Yes—eff. 7-1-58	Yes—by authority of House Bill 360, 1959	No	Yes--eff. 11-50	No	Yes—eff. 12-58
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes	Yes--Coordinator, by authority of Rev. St. Statutes eff. 8-20-55	No	Yes--Coordinator and Commission	No	No
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	No	No (proposed)	No	No
REMARKS		Programs inventoried 6-3-59	Programs inventoried 9-12-58			Programs inventoried 6-12-59	

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Mississippi 3-15-60	Missouri 6-16-60	Montana 5-13-60	Nebraska 6-16-60	Nevada 6-16-60	New Hampshire 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	No (proposed)	No (have limited authority under Industrial Hygiene Act and Hospital Licensing Laws)	No	No	No (proposed)
RADIATION CODE or REGULATIONS		No	No	No	No	Yes	No
REGISTRATION of RADIATION SOURCES REQUIRED		No	No (proposed)	No	No	No (proposed)	No (proposed)
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	No	No	No	No
	BANNED	Yes--eff. 7-58	No	Yes--effective 4-58	No	No	No
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes--Governor's Committee	Yes--commission by authority Senate Bill 6, eff. 3-4-59	No	Yes--Coordinator and Committee--by authority Legislative Bill 365 eff. 6-25-59	No	Yes. 8-55
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	No	No	No	No
REMARKS			Programs inventoried	Programs inventoried 6-30-59		Programs inventoried 7-8-59	

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		New Jersey 3-22-60	New Mexico 6-16-60	New York 6-16-60	North Carolina 6-16-60	North Dakota 6-16-60	Ohio 3-30-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—model APHA RPA by authority of Pub. Laws, Chap. 116, 1958	Yes—by authority of Sen. Bill 61, eff. 6-12-59 (not model APHA RPA)	Yes--by authority of Pub. Hlth. Law. Sec. 201 (s)	Yes—by authority of Sen. Bill 253, eff. 5-21-59 (not model APHA·RPA)	No	Yes—model APHA RPA
RADIATION CODE or REGULATIONS		Yes—by authority RPA. Act in 2 parts: Chap. 1, Gen. Requirements. Chap. 11,Spec. Requirements.	No (authorized by Enabling Act)	Yes	No (proposed)	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		Yes (see Enabling Act	Yes—by authority of Enabling Act	Yes	No (proposed)	Yes	No (proposed)
SHOE FITTING FLUORO-SCOPES	REGULATED	Yes—eff. 1-15-53	No	No	No	No—authority by Chap. 185, 1957	No
	BANNED	No	Yes—by authority of Sen. Bill 6, eff. 6-59	Yes—eff. 7-1-58	No	No	Yes—by authority of House Bill 294, eff. 5-58
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	No	Yes	Yes--Coordinator and Committee	Yes—Advisory Com. to Governor	No	Yes—by author thority of Senate Bill 339, eff. 6-12-57
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	Yes--Com. on Rad. Protection by authority Enabling Act	Yes—by authority Enabling Act	Yes—Intra-departmental Committee	Yes—by authority of Enabling Act	No	Yes—by authority of House Bill 410, eff. 2-60
REMARKS		Programs inventoried	Programs inventoried 5-25-59	Programs inventoried 8-25-58	Programs inventoried 1-27-59		Programs inventoried 8-4-58

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Oklahoma 4-4-60	Oregon 6-16-60	Pennsylvania 3-21-60	Rhode Island 6-16-60	South Carolina 6-16-60	South Dakota 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—by authority of House Bill 583, eff. 7-16-59 (broad gen. act which exempts healing arts)	Yes—1957	No (proposed)	No (proposed)	No	No
RADIATION CODE or REGULATIONS		No (proposed)	No (proposed)	Yes—by authority of Regulation 433 adopted 10-20-56	No (proposed)	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		No (proposed)	No	Yes	No (proposed)	No	Yes
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	No	No	Yes	No
	BANNED	No	Yes--1958	Yes	No	No	Yes 9-57
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—advisory committee, by authority of House Bill 583 1959	No	No (proposed)	Yes—Governor's Committee on Atomic Energy	Yes—Committee, authorized by Act 171, 3-25-59	No
	COMMITTEE ON RADIATION (TO STATE HEALTH AGENCY)	Yes--Committee on Rad. Legislation	Yes—by authority Chap. 339, eff. 7-1-57	Yes	No	No	No
REMARKS		Programs inventoried 7-30-58	Programs inventoried 12-12-58	Programs inventoried 6-3-59	Programs inventored 2-13-59		

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Tennessee 3-18-60	Texas 3-28-60	Utah 5-13-60	Vermont 6-16-60	Virginia 6-16-60	Washington 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—by authority of Pub. Acts Chap. 66, eff. 7-1-57	No (proposed)	No	No (proposed)	No (proposed)	Yes—(limited)
RADIATION CODE or REGULATIONS		No (proposed)	Yes--by authority of House Bill 71 of 1959 (Workman's Compensation)	No	No	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		Yes	Yes	No (registration of isotopes requested)	No (proposed)	No (proposed)	No (proposed)
SHOE FITTING FLUOROSCOPES	REGULATED	Yes	No	No	No	No	No
	BANNED	No	Yes	No	Yes 6-57	Yes 3-58	No
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes--Advisory Committee, by authority of Chap. 324, eff. 1957	Yes—Governor's Study Commission	No	No	No (proposed)	Yes
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	Yes	No	No	No
REMARKS		Programs inventoried	Programs inventoried 7-17-58	Programs inventoried 2-16-59	Programs inventoried 11-20-58		Programs inventoried 7-15-59

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH--Con.

		West Virginia 6-16-60	Wyoming 6-16-60	Wisconsin 3-21-59	Puerto Rico 4-21-60	Virgin Islands 4-21-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	No	No (proposed)	No	No
RADIATION CODE or REGULATIONS		No	No	No	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		No	Yes	No (proposed)	No (proposed)	No
SHOE FITTING FLUORO-SCOPES	REGULATED	Yes	Yes—by authority of Gen. Hlth. Laws Feb. 1952	No	No	No*
	BANNED	No	No	Yes--eff. 7-59	No	No*
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	No	No	Yes—Committee	No	No
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	Yes	No (proposed)	Yes—Radiation Protection Unit, Dept. of Health organized in October 1959	No
REMARKS			Programs inventoried 2-12-59			*There are no shoe fitting fluoroscopes operating to date

RADIATION EXPOSURES FROM FALLOUT

The Atomic Energy Commission has released a report on radiation exposures in the United States from nuclear test fallout, with special references to the short lived isotopes present in the fallout debris and to the existence of "hot spots." The summary of this report, prepared by the Division of Biology and Medicine, AEC, is reproduced below. The report will be reproduced as Technical Information Services document TID 8527 and made available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

THE CONTRIBUTION OF SHORT LIVED ISOTOPES AND HOT SPOTS TO RADIATION EXPOSURE IN THE UNITED STATES FROM NUCLEAR TEST FALLOUT

SUMMARY

This report is concerned with the extent to which segments of the United States population have received or will receive radiation doses due to radioactive fallout from nuclear testing to date which are significantly higher than the average for the country as a whole. The question of the biological effect or acceptability of such doses is not considered, but average natural background exposure is given as a reference level for comparison. Both short and long lived isotopes in the fallout are considered, and irradiation from internal and external sources.

Estimates are given of the average and above-average doses to the whole body and to the bone, bone marrow, and thyroid. These organs have received larger doses than has the whole body due to their internal concentration of the radioactive isotopes of strontium, barium or iodine.

The very complicated subject of exposure of the population to medical and industrial sources or radiation—sometimes used as a basis for evaluating the hazards due to fallout—has not been studied here. Some background material on this subject may be found in Appendix V. *

In accordance with accepted practice, a 70-year dose is given as a rough measure of the hazard to the present generation. It should be noted, however, that the biological effects of a given 70-year dose depend upon when this dose is delivered throughout the lifetime of an individual. Similarly a 30 year dose is given as a rough measure of the hazard to future generations. Finally a 1-year dose is given as a more appropriate measure of the hazard to infants and children, who may have especial sensitivity to radiation. For the evaluation of some biological effects, it may also be necessary to consider doses over time intervals much shorter than one year. For example, there are evidently times during the first three months of pregnancy when the fetus is particularly sensitive to injury from radiation. Due to short lived activities, there are many situations in which the 70-year dose from fallout may be delivered largely in a period of a few months.

Estimates of above-average doses are made only for situations for which data are available and indicate a relatively high exposure, and not for all cases of interest.

The numerical conclusions concerning the average doses in the U. S. to the whole body and to specific organs from testing to date are shown in Table S-1.

The time interval over which the estimates of Table S-1 apply are those intervals of 1,30, and 70 years for which a critical segment of the U. S. population receives the largest dose. For whole body external gamma radiation, the 30 and 70 year doses from testing to date would be largest for persons living from about 1950 to 1980, and 1950 through 2020 respectively. The largest strontium-90 concentrations in the bone are estimated to occur in children born in 1962-1963, and the calculations of the 30 and 70-year bone doses were made starting at the time. Strictly speaking then, it is not correct to add the maximum 30 and 70 year whole body external gamma doses to the maximum 30 and 70 year whole body strontium-90 bone doses when computing the maximum 30 and 70 year total bone doses, although this has been done in Table S-1.

Such an addition of the whole body dose to that of specific organs from internal emitters has not been made to obtain an estimate of the highest 1 year average dose to the bone, bone marrow, and thyroid since the year with the highest annual doses to each of these specific organs from internal emitters does not overlap the year with the highest whole body dose.

Estimates of the above-average doses are summarized in Table S-2.

Perhaps the most surprising above average doses given in Table S-2 are those to the thyroids of infants in areas where the highest concentrations of the short lived isotope Iodine-131 (8 day half life) were reported in milk. This dose in St. Louis for the year starting in May 1957 was computed to be 1900 mrad, or 19 times that delivered to the thyroid by the average natural backround radiation for that year. The similarly computed dose for the following year was 600 mrad.

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*Appendices referred to in the summary are contained in the original document.

TABLE S-1.—AVERAGE DOSES TO PEOPLE IN THE U. S. TO THE WHOLE BODY AND TO SPECIFIC ORGANS FROM FALLOUT FROM NUCLEAR TESTS CONDUCTED THROUGH 1958 AND FROM NATURAL BACKGROUND RADIATION

(All doses expressed in millirads)

	For 1 year period	For 30 year period	For 70 year period
Average whole body--Gonadal dose from fallout	11-14	45-100	50-130
From external gamma radiation	10-12	40-60	45-65
From internal cesium	1-2	5-40	5-65
AVERAGE WHOLE BODY—GONADAL DOSE FROM NATURAL BACKGROUND RADIATION	100	3,000	7,000
Average bone dose from fallout to children born in U. S. in 1962-63	-	480-540	740-820
From strontium-90	21	440	690
From whole body radiation	11-14	45-100	50-130
AVERAGE BONE DOSE FROM NATURAL BACKGROUND RADIATION	130	3,900	9,100
Average bone marrow dose from fallout to children born in U. S. in 1962-63	-	190-250	280-360
From strontium-90	7	150	230
From whole body radiation	11-14	45-100	50-130
AVERAGE BONE MARROW DOSE FROM NATURAL BACKGROUND RADIATION	95	2,900	6,700
Average thyroid dose from children under 10 from fallout	-	240-500	250-530
From radioactive iodine in fallout	100-200	200-400	200-400
From whole body radiation	11-14	45-100	50-130
AVERAGE THYROID DOSE FROM NATURAL BACKGROUND	100	3,000	7,000

The largest above-average doses reported were those to the whole body for persons within 200 miles of the Nevada Test Site. Of the 180,000 persons concerned, 120,000 received whole body external gamma doses lying between 100 and 6,000 mrads with an average exposure of 700 mrads. This is 14 times the average 30 year external gamma exposure from fallout of about 50 mrad. As shown in Table S-2, about 10,000 persons received whole body, external gamma doses in the range of 3000 to 5000 mrad. No information is available on the Iodine-131 content of milk in the Nevada Test Site area for the periods of active testing.

It may be noted that some of the doses, such as those to the thyroid from Iodine-131 were essentially delivered within 3 months from the time nuclear testing stopped. Others, such as those to the bone from the long lived isotope strontium-90 will be delivered slowly over the lifetime of the individuals being born today and in the next few years. A tabulation of the half lives of those radioactive isotopes contained in fallout which receive individual attention in this report, together with a schedule of the fraction of the total dose from each of them which is delivered by the expiration of one or more half lives after intake, is given in Appendix IV.

In addition to the information presented in Table S-2, estimates have been made of some external and internal doses from particular instances in which fallout from the Nevada Test Site has been depos-

TABLE S-2.—ESTIMATES OF SOME ABOVE-AVERAGE DOSES IN THE U. S. TO THE WHOLE BODY AND TO SPECIFIC ORGANS FROM FALLOUT FROM NUCLEAR TESTS CONDUCTED THROUGH 1958

(All doses expressed in millirads)

Whole body external gamma dose from local fallout to persons within 200 miles of the Nevada Test Site

76,000 persons	100-300	Most of the cumulative 70 year (lifetime) dose here indicated for persons within 200 miles of the Nevada Test Site were delivered during the years of actual testing from the from the short-lived isotopes in the fallout.
26,000 persons	300-1,000	
10,000 persons	1,000-3,000	
9,000 persons	3,000-5,000	
100-500 persons	5,000-6,000	

Thyroid dose from iodine I-131 estimated for infants raised on fresh cow's milk from the milk-sheds surrounding several U. S. cities for the period May 1957 through April 1958

St. Louis, Mo.	1,900	The thyroid doses reported here are those due to nuclear tests conducted since 1957, and are based on reported I-131 (half life 8.1 days) concentrations in milk. Similar data are not available for the period before 1957. (See p.2524, Ref. 6 for list of Nevada tests prior to 1957.) Short lived isotopes of iodine may increase the dose reported in the range of 15 to 40 percent if ingestion begins within 50 hours following detonation. Some dose possible from inhalation.
Salt Lake City, Utah	1,800	
Cincinnati	1,000	
New York City	580	
Sacramento	220	

	Highest for 1 year	Highest for 30 years	Highest for 70 years
Strontium-90 bone dose to 1% of children born in U. S. in 1962-63	100	2,200	3,500
Strontium-90 bone marrow dose to 1% of children born in 1962-63	35	730	1,200
Average strontium-89 bone dose to infants in St. Louis, Mo., born in May 1958, and subsequently fed for 1 year with fresh cow's milk. (St. Louis milk had the highest reported average concentration of strontium-89 for a 1 year period)	50	55 (assuming no more Sr-89 ingested after May 1959)	55 (assuming no more Sr-89 ingested after May 1959)
Average strontium-90 bone dose to infants in St. Louis, Mo., born in May 1958 and subsequently fed with fresh cow's milk	30	-	-
Average Ba-140 dose to infants born in St. Louis, Mo., Aug. 1957 and subsequently fed for 1 year with fresh cow's milk (St. Louis had the highest reported average concentration of Ba-140 for a 1 year period)	*10-35	* ~ 10-40	* ~ 10-40

*Assuming no more Ba-140 ingested after August 1958.

ited at large distances from the site relatively soon after detonation, usually through the action of rainstorms coincident with a cloud of fresh radioactive debris. This information is shown in Table S-3.

It is estimated that about one sixth of the persons exposed in these hot spot areas received half the average whole body external gamma dose, and one sixth twice the average whole body external gamma dose.

Also shown on Table S-3 is an estimate of the lung and thyroid dose due to inhalation in a single instance of heavy fallout.

There have been many occasions when the dose rate due to fallout has significantly increased the external gamma level from natural background radiation (roughly 100 mrad/year, or 11.4 μrad/hour) at areas far removed from the Nevada Test Site for periods of hours, days or months. For example, readings reported by the Public Health Service indicate 50 μrad/hr at Albany, New York for June 4, 1957, and about 75 μrad/hr at Salt Lake City for August 20 and 21, 1957. A survey by the Health and Safety Laboratory of the Atomic Energy Commission noted that readings of 40 μrad/hr in Brinkley, Arkansas in 1957 had dropped to 10.2 μrad/hr by 1959. During the incident in the Troy-Albany area in 1953, a reading of 10,000 μrad/hr was reported in Troy. Such incidents of temporarily high dose rates were evidently restricted in area and duration, and are not believed to have resulted in any significant change in the average exposure for the whole country for a period of time as long as one year. However, as noted below, the relatively heavy fallout over the entire northern hemisphere in the spring of 1959 does appear to have had a significant effect on the average exposure of the U. S. for the calendar year 1959.

According to the soil measurements of Gustafson at the Argonne National Laboratory near Chicago (and presumably representative of fallout at this latitude), six fission products (Zr^{95}, Cs^{137}, Ru^{106}, Ru^{103}, Ce^{141}, and Ce^{144}) gave rise to an open field dose rate of 8.5 μrad/hr for the month of May 1959. This is 75 percent of the average whole body dose rate from natural background radiation (external and internal). The data also indicate an open field dose rate for the United States of 71 percent of average natural background for the 3 months period beginning in April 1959, and 48 percent of average natural background for the calendar year 1959.

Gustafson suggests that the dose which would be delivered in an open field should be reduced by a factor of 4 to 5 in determining the average exposure of the population to account for the shielding effect of buildings. With such a reduction, the average external gamma dose from fallout for persons in the United States during 1959 becomes 10-12 mrad. Adding to this an average whole body dose of 1-2 mrad from internally deposited Cesium 137, one obtains an average whole body dose for this year of from 11

TABLE S-3

WHOLE BODY EXTERNAL GAMMA DOSES TO PEOPLE RESULTING FROM SPECIFIC INSTANCES OF HEAVY FALLOUT AT LARGE DISTANCES FROM THE NEVADA TEST SITE

Location	Date of fallout	Computed dose from time of fallout to 1 year thereafter, assuming an overall reduction of 5-10 from the infinite plane dose
Jefferson City, Mo.	July 9-10, 1957	1-2 mrad
North Dakota	July 16, 1957	4-8 mrad
Troy, N. Y.	April 26, 1953	7-14 mrad
Salt Lake City, Utah	March 24, 1953	4-8 mrad

INHALATION DOSE TO THE LUNGS AND THYROIDS RESULTING FROM A SPECIFIC INSTANCE OF HEAVY FALLOUT

Location	Date of fallout	Calculated dose from short-lived isotopes
St. George, Utah (130 miles from Nevada Test Site)	May 19-20, 1953	230 mrem to lungs (from gross fission product) 280 mrem to thyroid (from iodine)

to 14 percent that of average natural background. Perhaps 1/6th of the population would receive half, and 1/6th twice this average dose.

In this paper (for example in Table S-3) a reduction factor of from 5 to 10 has been applied to take into account the extent to which the average external gamma dose to the population from fallout is reduced by terrain roughness, weathering, and the shielding effect of buildings from what it would be if all the fallout were deposited on a flat, impenetrable plane, and a person remained continously exposed at 3 feet above the surface of that plane. This is roughly compatible with Gustafson's reduction factor of from 4 to 5 between the open field dose and the actual average dose to the population. The open field dose rate is estimated to be about three quarters of the calculated infinite plane dose rate for a month or so after deposition. For a period of several years thereafter it is assumed than an additional reduction factor of two crudely approximates the average additional reduction due to weathering, that is, due to the shielding provided by the earth as the fallout particles gradually make their way down into the soil. It should be emphasized, however, that there is not very satisfactory evidence as to what reduction factors should be applied either to the infinite plane or the open field dose to obtain the average population dose, nor is there very satisfactory information as to what fraction of the population receives external gamma doses appreciably above and below the average.

Some investigations of the biological consequences of fallout have assumed that even a very small exposure to radiation carries with it the probability of producing some biological effect which, although small, is proportional to the dose delivered. We do not discuss the general validity of an assumption of this type, but rather note that it implies that the total number of biological effects of a given kind which are eventually produced in the United States as the result of fallout radiation would be proportional to the sum of all the individual exposures. To evaluate the contribution of hot spots to the total number of biological effects in the United States according to this hypothesis, it would be necessary to compare the sum of the reported exposures in a given hot spot area, and in all of them put together, with the corresponding sum for the United States as a whole.

Since 1951 there have been 74 reported above ground nuclear tests in Nevada, with a cumulative fission yield of about 1 megaton. It is not known how this debris has been deposited around the United States, what times in transit should be associated with its arrival from the various shots, or how many persons might have been exposed in areas where the open field gamma dose was significantly above the average. Crude calculations based on strontium-90 levels and assumed arrival times suggest that the external gamma dose from Nevada may exceed that from the world-wide fallout over many areas of the U. S. and that some significant fraction of the population—perhaps 10 million people—received an additional 100 mrad external gamma radiation from this source. A comparison is made in Table S-4 of the contribution of the Nevada Test Site to the sum of all individual U. S. exposures to external gamma radiation from nuclear testing to date. Since the numbers are so uncertain, one must draw conclusions with care. It does seem reasonable to conclude, however, that the location with the highest individual whole body, external gamma exposures, namely the area immediately surrounding the Nevada Test Site, contributes only about 1 percent of the total U. S. external gamma exposure from world wide fallout, and that the sum of all individual exposures in the U. S. from Nevada tests is greater than the corresponding sum to persons in the immediate vicinity of the Nevada Test Site. The sum of all individual, whole body, 30 year exposures of the population from fallout is estimated to be less than 4 per cent of the corresponding sum of individual whole body, 30 year exposures from natural background radiation.

Taking short lived isotopes to be those with a half life of 1 year or less, the following conclusions are reached as to their contribution to the average and above average doses from fallout in the United States, their relation to hot spots, and the contribution of hot spots to average and above average doses in the United States.

1. <u>Short Lived Isotopes and Average Whole Body Exposures</u>. Depending on the future contribution of internally deposited cesium to the whole body dose—which as shown in Table S-1 is uncertain within wide limits—short lived activities contribute from about 1/3 to 3/4 of the average 30 year, whole body dose in the United States, from about 1/4 to 2/3 of the average 70 year whole body dose, and over 4/5 of the highest 1 year average whole body dose. Their relative contribution to total population exposure (measured in man rads) is the same as their relative contribution to the average exposure.

2. <u>Short Lived Isotopes and Average Internal Exposures.</u> Both short and long lived isotopes may be taken into the body and concentrated in specific organs so as to produce doses to these organs which are greater than the whole body doses from fallout. As shown in Table S-2, the average 30 and 70 year doses to the bone from the long lived internal emitter strontium-90 are 5 to 10 times greater than the average 30 and 70 year whole body doses from fallout, and the average 30 and 70 year doses to the thyroids of children under 10 are 2 to 4 times greater than their average whole body exposure, although it should be noted that the short lived iodine delivers essentially all its dose within 3 months of the period of active testing rather than over a lifetime.

TABLE S-4.—CONTRIBUTIONS OF WORLD WIDE AND NEVADA TEST SITE FALLOUT TO THE 30 YEAR, WHOLE BODY POPULATION EXPOSURE OF THE UNITED STATES

Population	Description of dose	Total population exposure (man rads)
180,000 persons in area within 200 miles of the Nevada Test Site	Up to 6,000 mrad external gamma dose as shown in Table S-2[1]	90,000
An assumed 10 million persons considerably removed from the Nevada Test Site	100 mrads external gamma dose from Nevada tests[1]	1,000,000
180 million persons in the United States	Average external gamma dose of 50 mrad from world-wide fallout from all tests to date	9,000,000
180 million persons in the United States	Average whole body dose of 5-40 mrad due to internal cesium-137 from world-wide fallout	900,000 - 7,200,000
180 million persons in the United States	Average whole body dose of 3000 mrad due to average natural background radiation, external and internal	540,000,000

[1]There will be an additional whole body exposure due to internal emitters which has not been evaluated here.

3. The Contribution of Short Lived Isotopes to Above Average External Gamma Exposures From Nevada Test Site Fallout. A rough estimate of the extent to which isotopes with half lives shorter than 1 week could have affected external gamma exposures in areas which received repeated depositions of fresh debris from the Nevada Test Site may be made from a schedule of fission product decay rates and integrated doses (Table 1, Appendix II). The decay schedule indicates that fallout which arrives at 6 hours after detonation produces about twice the external gamma dose during the following year as does the same level of fallout (measured, say, in terms of millicuries of strontium 90 per square mile) arriving 2 days after detonation, and 3 times the dose of fallout arriving 1 week after detonation.

4. Hot Spots and Their Effect Upon Average and Above Average Doses. The available data suggests that there are areas in the United States, presumably the dimensions of counties or states, where any or all of the radioactivities in fallout have been deposited in surface concentrations clearly above those in surrounding areas and above the average level for the United States as a whole. The evidence for these "hot spot" areas is reflected by high measurements of gamma or beta activity at various times and in scattered locations, in high concentrations of iodine-131 in some of the milk which has been analyzed, and to a lesser extent, in variations in the strontium-90 content of soils and food products.

Above average, whole body, external gamma doses to segments of the population may be presumed directly related to those geographical areas where the above average fallout occurred, and thyroid doses from radioactive iodine to areas where the milk and food products from the hot spot areas are consumed within 2 weeks after production. Above average concentrations of strontium-90 in individual food products from particular areas, particularly wheat and dairy products, affect the strontium-90 intake of persons wherever the food products are consumed. The variation of individual strontium-90 intake is affected by many other factors than high cumulative levels of strontium-90 in specific geographical areas, however, and the geographical variation does not enter directly into the estimates made here of above average doses to the bone and bone marrow from strontium-90.

The location, size, and population affected by individual hot spots, and the extent to which they alter the total exposure of the population is not known. The available evidence suggests that the estimates of average and total population exposure in the U. S. would not be greatly changed from the ones given if more were known about the size and location of hot spot areas.

A principal reason for interest in hot spot areas is to learn to what extent individuals and small segments of the population may have received doses to the whole body or particular organs which are many times greater than the average from fallout, or appreciably greater than natural background radiation over time periods as short as 1 year. As shown in Table S-2, this has occurred for whole body exposures in the area immediately surrounding the Nevada Test Site, and appears to have occurred to the thyroids of infants who drank fresh milk from the milksheds around several large U. S. cities during the years of active testing at the Nevada Test Site. A discussion of the possibility of other areas with significantly above average exposures may be found in the body of the report.

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